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THE RELATIONSHIP BETWEEN PSYCHOLOGY AND SCIENCE

THE RELATIONSHIP BETWEEN PSYCHOLOGY AND SCIENCE

BY

WILLIAM TAYLOR

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TO ELSIE

for her grace, beauty—and coffee

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The relationship between psychology and science, that is to say between mind and matter, constitutes the theme of this book. Assuming the existence of Cartesian (not Aristotelian) substance, having the power of experiencing and causing change, four main alternatives are possible. All have been proposed before. They are that:—

(i) mind and matter are two quite distinct and different substances,
(ii) they are different 'aspects' of one 'neutral' substance,
(iii) matter is the only substance,
(iv) mind is the only substance.

From the evidence of science I identify matter with the invariably unsubstantial (non-causative) sense-data or sensa, within the sense-fields of individual minds (bodies). Thus, I adopt the fourth alternative, involving the retention of Cartesian epistemological dualism but the rejection of Cartesian psycho-physical dualism.

The prime factors of matter (sensa) are the three scientific factors; electricity, magnetism, and the third, which I have named 'mesonism', because its presence was first demonstrated in atomic "particles" called "mesons". Gravitation is the undifferentiated complex of the three prime factors in "fields", whilst matter is this complex in "bodies". From the assumption that there are three prime scientific factors, then what has not been possible formerly, namely a satisfactory picture of the wave-particle nature and the wave-path of a fundamental "particle" can be achieved. This is taken to be evidence of the correctness of the assumption.

The prime factors of mind, up to the present unknown in number and therefore also in qualities, must be at least three in number. Otherwise the differentiation and distinction between

the three prime scientific factors could not have been made by mind. It is not necessary to suppose that there are more than three prime psychic factors.

The three Platonic psychic factors:—volition, intellect, and emotion, are thought best to provide for the essential qualities of mind. From their qualities including that of polarity, it can be inferred that the psychic and scientific factors are related in the pairs:—volition with electricity, intellect with magnetism, emotion with mesonism. Confirmatory evidence, for the general hypothesis put forward, covering a wide range of experience both scientific and general, follows.

The relationship of the three absolute values of the universe with the three psychic factors (and thus with the scientific factors); of goodness with volition, of truth (intellectual) with intellect, and of beauty with emotion, is outlined.

This theory of the relationship between science and psychology involves the refutation of the Cartesian myth of the mind as the 'ghost in the machine' of the body (*cf.* G. Ryle, *The Concept of Mind*, 1949). It maintains that mind is *not* ghostlike, but is both substantial and corporeal, and that matter is neither substantial nor corporeal, but *is* ghostlike.

One aspect of current thought amongst scientists on the relationship between science and psychology may be expressed as follows:—it is highly probable that every process of thought or psychic experience has a physical basis, even if we are very far from being able to trace it out. The new theory would tend to reverse this position and would claim that every scientific "process" or "event" is based on a psychic process or event, even if at present we are very far from being able to trace the relationship in detail.

Herongate, Essex
June, 1951

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CHAPTER I

INTRODUCTION

THE abiding mystery of the universe confronts man afresh in each age and generation. Traditionally it has been thought to comprise four smaller, yet vast problems. These are the nature of: (1) the external world, (2) man's own internal world, (3) the prime origin and ultimate destiny of these two worlds, and (4) their relationship. The problems are not separate but all are overlapping parts of the whole. Each of them involves the others, yet because there has appeared to be a sharp antithesis between the qualities of the two worlds, the first and second problems have been largely separated from each other. Indeed three of them are now almost exclusively the concern of specialists; the first, of the physical scientist, skilled in the investigation of physical matter and fields; the second, of the psychologist, specialist in the investigation of mind and spirit; and the third, of the seer, who may be supposed to have revelation, through direct communion with the universe, of the alpha and omega, the beginning and the ending. Because of the widespread range of the fourth problem it has been the preserve of no particular kind of specialist but of the philosopher, so that the whole realm has been open to him.

The traditional analysis of the whole problem is designated 'metaphysical' by the logical positivist since it appears to have no 'scientific' meaning. That is to say it appears to be impossible for the postulated external world, being 'external,' to be experienced either in principle or in practice. However, if a hypothesis were to be advanced whereby man *could* be supposed to be capable of experiencing part at least of the 'external' world, and adequate evidence were given in its support, then even the positivist would no longer be able to deny intelligible meaning

to the traditional 'external' world. A hypothesis of this kind with the requisite evidence is submitted in this book. In so far as it is found to be acceptable, the traditional analysis of the problem of the universe would be justified and would assimilate to itself the modern approach to the problem. Then in spite of the modern analytic movement in philosophy, it could still be accounted the philosopher's responsibility, even if he were quite understandably largely to fail in this, to attempt to reconcile otherwise conflicting partial solutions (offered by the specialists to interpret their own problems) in his attempt to read the whole riddle. Generally, he could be expected not only to analyse but also to synthesise; to attempt to see not only 'the many in the one,' but also 'the one in the many.' He could be expected to ask himself therefore whether there is an absolute unity. And if he were to decide that there *is* then he must meet problems such as: (1) the manner of union of man's internal world with the external world; (2) the manner of union within the external world of the very great variety and untold number of terrestrial creatures with each other, with the earth itself and with the 'heavenly' bodies, including the many nebulae; (3) the way in which the different species, as sulphur and iron, the amoeba and the lion, the rose and the lichen, are all derived from the same unitary source; and (4) the origin of the dualities of good and evil, truth and falsehood, beauty and ugliness, freedom and slavery, love and hate, etc.

Some would say that God is the creator of the whole universe and that, therefore, it is He who supplies the absolute unity within which all created things exist. Many scientists would not accept this solution to the problem, if, by God, were implied some supernatural being or *deus ex machina*. Instead, they would prefer to think of God—if at all—in terms of natural processes where a natural process is a physical process of the kind investigated by scientists. They would pursue the explanation, in these terms, as far as possible, until such explanation becomes impossible, when what has been called the 'alogical core' of the universe has been reached. This kind of interpretation of the universe is not necessarily irreligious. It may coincide with the concept of God,

(a) as being partially immanent in the universe and therefore so far understandable in terms of natural processes and (b) as being wholly the universe, and yet to some extent transcendental and inexplicable (alogical) to the individuals composing Him. The nature of God, assuming that He exists, and indeed the very possibility of His existence, must be allowed to be matters of the utmost concern for mankind.

The success of the scientists in obtaining knowledge of, and consequently power over, the external world will probably be generally admitted. In physical science there is no room for vague opinion, but room only for definite, precise, and accurate, knowledge. The latter is at a maximum and the former at a minimum in this province of human knowledge. Psychology is in a different position. Here advance has been slower and knowledge is less adequate and certain. Knowledge of the relationship between psychology and physical science is still less adequate and certain. This is due partially to our limited knowledge of both, but particularly of psychology, and partially to the apparently irreconcilable qualitative differences between what concerns it—mind—and what is supposed to concern physical science—matter.

One grave danger for philosophy is that, in endeavouring critically to analyse the positions reached, and the views expressed, by the various kinds of specialists, and in endeavouring to reconcile these in broad generalisations, sufficient account may not be taken of the details of the three specialist regions of human knowledge. There is, however, also the danger of *not* attempting to view and to comprehend the whole problem, and this danger with its attendant evils appears to be more pressing to-day than the former. It is the danger produced by our bewilderment at the size and complexity of the whole problem, and by our humble assumption, tinged with pessimism, that we are too ignorant both of content and of method of procedure, to cope with it. If we adopt, still in all appropriate humility, a more optimistic outlook towards the problem, then, as in chemical science, analysis into recognisable constituents must precede any

successful synthesis. It is here contended that recent scientific investigation has carried the work of analysis far enough to enable a start to be made with that of synthesis. Although a final assessment of our method of synthesis and the reasonableness of our arguments must be left to others, interim assessments have been attempted during the work by reference largely to human experience in the world of science.

The specialists, for the most part, appear to be content to work in their own particular fields without much, if any, reference to the work of experts in other fields. Their several solutions to their various problems, even if they are apparently adequate to explain and not merely to describe the results of their specialised investigations, either lead them to blank walls as with the scientists and psychologists, or are so unrelated to science and psychology, as with the prophets and seers, that the wind or even the breath of argument causes men's minds to veer from religious belief to unbelief and back again with undue and unhealthy rapidity. As an instance of the former result Professor E. D. Adrian (*The Physical Background of Perception*, p. 1) has confessed "the complete inability of contemporary science to give a satisfactory picture of any kind of mental activity. No one would deny that present inability. . . . The final objective is to find out how the activity of the brain is related to that of the mind." The isolation of physical science from psychology must have a somewhat deadening and stultifying effect on the work of both kinds of specialists, even though they may assert that this is not so. This effect can be inferred because one has only to suppose the establishment of a firm bond between physical science and psychology to envisage what greatly increased inspiration and activity would thereby be aroused amongst scientists and psychologists.

There is no need—at least I shall assume this—to quote any special instance of the second result since it would perhaps be generally agreed that there is a common lack of confidence of contemporary man in his own understanding, and especially a lack of firmly based moral and religious convictions, firmly based

that is, on a foundation not only of what might be called authoritative revelation, but also on at least a measure of coincidence of this with reason—a mental attribute and so related to psychology —and with the comparatively certain yet empirically based knowledge of science. But if the two latter are not clearly and strongly linked together, and it is undoubted that at present they are not so linked, then there can be little hope of them providing a firm basis for human religious and moral convictions. It is probable then that the present common uncertainty is primarily due to the absence of any clear, well-founded, and generally accepted, interpretation of the relationship between man's fairly sure knowledge of the world external to himself and the much more uncertain knowledge of himself, his own internal world, that is to say, between science and psychology. If man's knowledge of science could be keyed with that of psychology the present relatively unsure structure of the latter would certainly be strengthened and knowledge of the former might reciprocally also be rendered still more secure. What would appear to be required is some hypothesis whereby they could be linked together. Such a hypothesis, which has been mentioned previously (page 9), if confirmed by its success in practice, could then be the first stage in restoring man's confidence in his own understanding. Our present aim is to provide a possible hypothesis of this kind (Chapter IV) and a brief account of how it could be applied to help the understanding of the three kinds of specialists (Chapters V and VI) and of man in general (Chapters VII and VIII).

It may be objected out of hand that extended but unthinking 'matter' and non-extended but thinking 'mind' are so manifestly qualitatively distinct, as Descartes held, that the surer knowledge of physical science cannot be directly related to the less sure knowledge of psychology and hence that the proposed method of procedure is doomed to failure. This remains to be seen. No summary and pre-conceived judgement of this kind should be adopted concerning the proposal until it has been more closely examined. It is reasonable to suppose that real

progress in this first stage can only be made by proceeding from a region where knowledge is most sure, to regions where it is less sure. This is akin to Descartes' plan (*Discourse on Method*, Part IV). He started from the presumed absolute necessity of his own existence as a knower: "and finally, when I considered that the very thoughts (presentations) which we experience when awake may also be experienced when we are asleep, while there is at that time not one of them true, I supposed that all the objects (presentations) that had ever entered into my mind when awake had in them no more truth than the illusions of my dreams. But immediately upon this I observed that, whilst I thus wished to think that all was false, it was absolutely necessary that I, who thus thought, should be somewhat, and as I observed that this truth, *I think, hence I am,* was so certain and of such evidence, that no grounds of doubt, however extravagant, could be alleged by the sceptics, capable of shaking it, I concluded that I might, without scruple, accept it as the first principle of the philosophy of which I was in search."

In brief it may be said that I would agree, by and large, with this, his original supposition and starting point, but in the modified form that there undoubtedly is a situation or event of knowing and I will label this 'myself'. This initial proposition may not be wholly acceptable, largely because of Hume's strictures on the concept of 'self.' However, the 'myself', being controversial, need only be accepted as a label, for want of a better and more appropriate term, and not as an additional proposition—in favour of the existence of my 'ego'. That is all that is intended and asked; the acceptance of the unique event of knowing, labelled 'myself' as the ground and starting point for this enquiry. Although one would agree that the stuff and qualities of dream objects are the same, apart from the quality of orderliness, as the stuff and qualities of the objects of my waking life and that therefore, in this sense, both kinds of 'objects' are equally true or equally false, yet the latter are here believed to *represent* within me ontological or external beings existing independently, or almost independently, of me, whereas

the former or dream objects do not represent beings of this kind. In this sense dream objects are regarded as false and the objects of waking life as true. Such a standpoint involving a belief in the independent, or almost independent, existence of a world external to the knower and involving also a theory of sense-perception as giving him mere representation of this world, requires justification especially as it is now out of favour.

It is a standpoint which generally coincides with that of Descartes, who can be regarded as the modern source of the conception of representative sense-perception. As it is of fundamental importance to our main objective, which is to link science with psychology, our more detailed standpoint will be discussed at the earliest opportunity. In the meantime it must suffice to state that initially the argument will rest, first on the certain existence of an event of knowing (myself) next on my fairly sure knowledge of the existence of other events including other people like myself, and then on our common relatively sure knowledge, of physical science, sure that is so far as it goes. Because *my* knowledge of other people and *our* common scientific knowledge of events in the external world arises out of sense-perception (extra-sensory perception constituting a negligible pathway of knowledge of the external world) I shall now proceed to discuss this.

CHAPTER II

OUR KNOWLEDGE OF THE EXTERNAL WORLD

Introduction to Sense-perception

The man who is content to use common-sense alone and who does not reflect on the part played in sense-perception by his brain and nervous system; on the significance of the finite speeds of light, sound, and nerve impulse; on the effect of drugs on his vision; on perspective; on the images formed in mirrors and lenses; on mirage images—not to mention the images of dreams and hallucinations—this man assumes that sense-perception reveals external or physical objects as they are in themselves. This is the belief of the naïve realist. For him the "table", as revealed by sight and touch, is the *table* as it is in essential reality, the thing-in-itself. For him there are not two or more tables but one only, and it exists outside him, which is to say, independently of him, having at any one moment, a definite single position in space. This space contains him, or at least his 'body', and all the things which he perceives through the senses, qualitatively and really as he perceives them. His belief in the singleness of the table and in its objective or external reality as presented to him in sense-perception, persists although the table has different colours, shapes, and sizes, when he perceives *it* from different positions and under differing conditions. If he were asked to explain how these different and multiple appearances of the table can be reconciled with his belief in its singleness he might say that they reveal it in its different and multiple aspects. This explanation would have the approval, by and large, of all common-sense and direct realists. But it will presently be shown, from the evidence catalogued above, that any common-sense interpretation of sense-perception involving the direct apprehension of the table

is not possible. However this demonstration will not disprove the existence of the single table believed in by all realists, irrespective of whether they are direct or indirect realists.

Such events as are indicated by statements like "I hear an aeroplane' or "I see a star" I shall designate "perceptual events." It would help us to clarify the meaning of certain terms if it were temporarily conceded that a perceptual event does not literally contain the object, *e.g.*, aeroplane, referred to in the statement indicating the event. The whole of this chapter and of chapter III is concerned with an attempt to show that this supposition is true. In the meantime it might at least be agreed that, if this supposition were false, then each of the perceptual events, indicated by the statements "I hear an aeroplane" and "I see an aeroplane", *would* literally contain the aeroplane, either wholly or partially, as a constituent. For the sake of our present argument we will accept only the former alternative. But any percipient knows that the noise (the aeroplane), which he experiences, is not the vision (the aeroplane) which he experiences. If then, the aural perceptual event were literally to contain the aeroplane, the visual event would not; which is a *reductio ad absurdum*. This argument is clearly far from conclusive and is intended only to show that the original supposition is not without some foundation in reason and I shall proceed to use it without further present consideration. I shall call the "aeroplane" which is noise or vision and is a constituent of the perceptual event, a "sensum." *A sensum is* defined as *any datum or content, having distinguishable temporal and spatial position, in the private experience of a sentient being (subject)*. From this definition it is possible that the experience may be that of a dream, hallucination, or memory, or that induced by electrical or other kind of stimulation of the appropriate nerve or brain area, or it may be that of sense-perception. The term "sensual event" will be used to comprise experiences of all kinds containing sensa. A "perceptual event" is one kind of sensual event. According to the description, it is possible that a sensum may be an ache or pain, pleasure as opposed to pain, hunger or thirst, heat or cold, etc., or it may be one of the more usually

accepted sensa such as a patch of colour, a sound, a touch, a taste, or a scent.

The aeroplane, which is not the sensum of the perceptual events referred to above, will be termed an "external object". During sensual events whether perceptual or not, the subject commonly assumes, though not necessarily consciously, the existence of a corresponding external object. In the externality of the object, which is to say its independence of the subject (but see pp. 60–61 and 69–71), lies usually any significance which the sensum has for the subject.

An act of sense-perception or a perceptual event contains an awareness of the sensum by the subject. This awareness cannot, however, be separated from that which is given, the sensum, in the perceptual event, because the sense datum is not presented unless there is an awareness of it by the subject. All other kinds of sensual events, namely, memory, dream, and hallucinatory events, and those excited through mere physical or chemical stimulation of nerve or brain, also include meaningful awareness of the sensum for the subject, even though, in these instances, there is no evidence to support the subject's intuitive apprehension of a corresponding external object. "Sensation" will be defined as a sensual event where the meaning of the sensum for the subject is negligible; that is to say where there is negligible intuitive reference by the subject to an external object.

Common-sense and sense-perception

We will now discuss sense-perception in some detail. The sensum "aeroplane" in the perceptual event indicated by "I hear an aeroplane" is a datum of sound situated, at a certain moment, at a definite spatial position in the percipient's sense-field. If we suppose that the percipient concurrently "sees" and "hears" the aeroplane, during a period of time sufficiently lengthy to allow of this concurrence, then the spatial position of his visual sensum at any moment differs from that of his aural sensum. The percipient's "sight" and "sound", both meaning "aeroplane", occupy different positions in his sense-field. There are then two sensa,

two "aeroplanes", differing at least in *quality* and *spatial position* at the same moment of time, in the time sequence of the subject. If there had been only one sensum, then this, being single, could have been the aeroplane intuitively assumed by the percipient to be revealed to him. The fact that there are two sensa in the event just described must raise doubts in any reflective percipient as to whether either of them is actually the external object, the aeroplane. There is no obvious reason why one sensum should have preference over the other in this respect. And even if one sensum were to be the external object the percipient would not be able to detect this, because neither bears a label to this effect nor discloses any clue to this kind of identity. So the mere presence of two sensa in the reflective percipient's sense-field must arouse doubts in him regarding the credentials of either to its claim to be identical with the intuitively assumed external object.

If we suppose that the percipient "sees" and "hears" the aeroplane for a brief period of time then the time of the visual sensum will be earlier than that of the aural sensum. The time difference of the visual and aural sensa is more easily experienced with a gunshot. In this instance, if the gunshot is remote from the percipient, the flash of light or visual sensum is experienced considerably before the clap of sound or aural sensum. The time-difference in each of these perceptual events would again raise doubts in any reflective percipient as to whether either of the two sensa, which differ in *quality* and *time*, is actually the external object. Combining the inferences of the two perceptual 'events' involving an aeroplane (of this and the previous paragraph), the conclusion is reached that my aural and visual sensa, these differing *temporally*, *spatially*, and *qualitatively*, from each other, exhibit duality. It is therefore doubtful whether either of them is actually *the* aeroplane. Similar doubts arise for my tactual and other sensa, from which it may be inferred that sensa do not present but merely represent the essential aeroplane to the subject.

The direct realist would not agree with this conclusion. He might contend that one kind of sensum, above all others, is usually so outstandingly vivid, clear, and detailed, and gives such

an impression of reliability to the percipient that he must, by these signs, identify it with the external object. This sensum could be the visual sensum. Alternatively the tactual sensum might be chosen. The validity of the claim to the identity, complete or partial, of the visual sensum and the external object will be examined now. Let us first consider the perceptual event indicated by "I see a star". The visual sensum, the "star" directly experienced by the percipient, is a point of radiance. But even the naïve realist would probably agree that the star is really a very large body, much larger, for example, than the earth. Thus the visual sensum is only representative, at least as regards size, of the external object, and cannot be identical with it. However, allowing for the great difference in size between the visual sensum and the star, they may still have the same basic qualities and be identical in time and in distance from the percipient. This would involve the assumption that the external object exists in a space and time identical with that of the sense-field. To discover whether this assumption is feasible or not we shall deal first with the possibility of the temporal identity of visual sensum and external object.

Because the visual sensum of the perceptual event is produced by light which travels—we will not pause now to examine the kind of space-time in which it travels—from the postulated external object to the percipient and because light has a finite velocity, the visual sensum must always be different in time from the external object so perceived. The time of the external object is the time when the light left it, for one cannot assume that the object remains the same during the period of travel of the light to the percipient. Granted the finite velocity of light then the time of the sensum must be later than that of the external object. This must be true of any visual sensum and the external object, thereby visually 'perceived', whether they are near together or far apart. The difference in time, if the 'perceived' external object is a star, may be of the order of hundreds or even thousands of years, but with nearby objects it may be only an infinitesimal fraction of a second. Nevertheless any visual sensum

and the corresponding external object must inevitably always be different in time.

We shall now turn to consider the possibility of the identity of place of the visual sensum and the external object visually 'perceived'. It is commonly held to-day, because of the work of Minkowski and Einstein's Theory of Relativity, that time and space are abstractions from their indissoluble union in 'space-time', as for example the 'space-time' of the 'absolute world' of Minkowski which will here be interpreted as being the 'space-time' of the external world. Yet time may be known by man without reference either to external or to sensual space-time, assuming for the sake of argument that these differ, through changes occurring in that part of his experience—desires, emotions, and conceptual thought—which, being internal, at least appear to him to have little or no necessary reference either to external objects or to sensa. This kind of time therefore may be independent of these two kinds of space-time. Thus we shall suppose it to be possible—it at least appears possible—to differentiate space from space-time as a cross-section of the latter at one instant, this instant being one chosen by a man from his own inner experience. Any sensual space will be regarded as that of one and the same percipient at all time-instants. Because two cross-sections of space-time of the same kind (sensual *or* physical) must be at two different time-instants, the two spaces isolated, though of the same kind, must be distinct and therefore different. Thus the position of a constituent (assuming this to persist) in space of either kind at one instant is truly distinct and different from the position of the same constituent in space of the same kind at any other instant.

If we assume that the sensum and relevant external object can both inhabit the same kind of space-time, then it is logically possible for them both to occupy, at the same instant, the same position in either of the two kinds of space or in a space which is an association of the two. However physical and psychical evidence shows that the logical possibility is a physical and psychical impossibility. This evidence, for a *visual* sensum and

the visually 'perceived' external object, is that of: (1) the finite velocity of light travelling from the external object to the percipient's eye (*physical*), (ii) the finite velocity of nerve impulses in the percipient (*physiological*) and (iii) the visual sensum being experienced by the percipient immediately on or after, never before, the nerve impulse reaching the brain and thereby inducing the sensum (*psychological*). In other words the time-instant, relating to the space holding the sensum (visual or otherwise), is always later than the time-instant relating to the space holding the external object, in the time reference-system of the percipient. Therefore the former space is always distinct from the latter, even though these may be qualitatively the same, so that the spatial as well as the temporal position of the sensum, visual or otherwise (*e.g.*, tactual), is always inevitably distinct and different from that of the corresponding external object.

On the assumption that time within a man can be known by him without reference to sensual or physical space-time, it has now been shown that any sensum is always inevitably different in temporal and spatial position from the 'perceived' external object. The sensum and the object 'perceived' are therefore always quite distinct and can never be mutually identified either wholly (naïve realism) or in part (common-sense realism).

However, if sensa and external objects are supposed to be qualitatively the same, then the two kinds of space-time, sensual and postulated physical, which they inhabit, must be qualitatively the same, for, if not, either or both kinds of space-time could not have the constituents which they purport to have, because of the incompatibility between the constituents or parts and the whole space-time(s). If also the percipient may be conceived to exist in the same postulated physical space-time as the external object which he 'perceives', then it is also conceivable for the sensum *apparently* to occupy the same position (in a physical-cum-sensual space-time) as the external object. This could appear to happen when the percipient, the centre of the sense-field or sensual space-time, and the external object are at rest, or almost

so, relative to each other, during the time taken by light to travel from the object to the percipient. Even the slightest change in the position of the percipient's head during this time would mean that the exact condition of relative rest had not been fulfilled, unless the external object changed position equally during the same time. This last possibility is most unlikely. However, where the external object and the percipient are near together then, owing to the very high velocity of light and the consequent very short time taken by light to travel from the object to the percipient, their relative motion will be negligible. Hence, where the external object is a table in the same room as the percipient, its time and place, the latter as confirmed by measured pacing followed by tactual perception, will apparently be that of the visual sensum. Where the external object is a star then, in spite of the high velocity of light, the relative motion of percipient and star will generally be far from negligible, and the time and position of the sensum, the "star", will correspondingly be different from those of the star itself.

In short, the time and position in postulated physical space-time, of a postulated external object, have been shown always to be distinct and different from the time and position, in sensual space-time, of a corresponding visual sensum, or any kind of sensum including the tactual. This is so, even if the object and the sensum and the space-times containing them are qualitatively the same and therefore could logically coincide. It may then be conceded that all sensa merely *represent* and do not *present* any postulated external objects in the experience of a sentient being. A sensum cannot be identical either wholly or in part with the external object thereby perceived, even on the most favourable assumption, namely that the external space-time is qualitatively similar to that of a man's sense-field.

The varieties of sensa

The extension of the meaning of the term "sensum" to include the content of sensual events other than perceptual, will now be justified. In any dream event the visual contents may, like those

of perceptual events, have size, shape, motion, and number. The parts of this content must therefore be mutually related, spatially and temporally. The "hills", the "sky", the "riders of the plains", of the dream event, exist in the space of the dream sense-field, just as do the sensa in the space of the sense-field of a perceptual event. Moreover the two kinds of space, dream and perceptual, are qualitatively the same, for their contents may each partake of colour, sound, touch, taste, scent, heat, cold, hunger, pain, etc. The same is true of hallucination, since the "pink elephants" seen by the drunkard occupy the space of the hallucinatory event, being shaped and coloured and related in space, externally to the drunkard's own perceived "body". Wordsworth's remembered golden daffodils "beside the lake, beneath the trees, fluttering and dancing in the breeze" can be paralleled by other visual memory events. Here also, although usually less vivid than sensa in visual perceptual events, the contents of the visual memory event are many, coloured, and spatially related to one another and to the subject. Memory events, which are not visual but are yet sensual, are similarly qualitatively the same as non-visual perceptual events. So far there is justification for the extension of the meaning of "sensum" to include the content of those sensual events already mentioned and other than perceptual.

The naïve realist would probably protest that the sensa of perceptual events, being in his belief identical with the external objects, are public and are therefore open to observation by many observers. Any direct realist would assert that a perceptual sensum may literally be the whole or part of a public external object. Whereas it would probably be generally agreed that the content of any other kind of sensual event is private and is therefore only capable of being observed by the subject of the event. The latter content would then be qualitatively different in this particular from a perceptual sensum and therefore both could not possibly be sensa. But we profess to have shown that all common-sense beliefs, concerning the complete or partial identification of sensum and public external object during sense-

perception, are untenable. Thus the contents of perceptual events *may be* private, like those of other sensual events. If they *are* private then the comprehensive use of the term "sensum" for all such contents would be justified alike on the grounds of spatio-temporality, quality and privacy. Positive evidence in support of the privacy of perceptual sensa is given later in this chapter.

Another part of the meaning which has been given to the term "sensum" must be clarified. Sensa have been defined (p. 17) as contents of experience which are mutually spatiotemporally related and are private to the subject having the experience. Therefore they would include what are commonly called "bodily feelings" or organic sensations; such data in experience as aches and pains, feelings of pleasure as opposed to pain, of hunger and thirst, and of heat and cold. What justification is there for adopting this wider meaning of the term? If a sensum were considered to be a datum of experience induced through the five main sense organs only, for example a patch of colour, a sound, a taste, a scent, or a touch, then a feeling of hunger or thirst, etc., might not be considered a sensum. However, even with this restricted meaning of the word, sensa would include contents of experience which are qualitatively widely different. Thus a colour is qualitatively very different from a sound. There then seems to be no reason on these grounds to oppose the adoption of the wider meaning proposed for the term. On the other hand there are two good reasons for its adoption; the first being that "bodily feelings" are undoubtedly private to the subject and yet are spatiotemporally related amongst themselves, and the second that there are sense organs of pain and heat as well as of touch. Although the sensa in the "mass of bodily feelings" are not so easily differentiated spatially as the others, they *can* be differentiated and like the others can therefore be located in the sense-field. It may be objected further, however, that unlike the sensa of sight and sound which are located outside a space denoted by the subject's visual sensum, his "body", and unlike those of touch, smell, and taste, which are located at the surface of this space, these bodily sensa—if they are sensa at all—are within

this space, and therefore in this respect are qualitatively different from other sensa. Many instances could be quoted to illustrate that there is no such difference. Two will suffice: (1) A doctor gives an injection to a middle-aged man whose right arm has been amputated several years previously and the man states that he then experiences a tingling in the middle and ring fingers of the missing arm; (2) it is possible for a person with a paralysed arm to get the sensation (kinæsthetic sensa) that it is waving about although he can see it hanging by his side. In such illustrations is to be found the evidence that the so-called bodily feelings or organic sensations can lie beyond the visually perceived body. Therefore bodily feelings may legitimately be regarded as sensa, because like sensa they are private and are not necessarily located within the visually perceived body but can be located beyond it.

This conclusion is also true for bodily feelings of tiredness, for aches and pains, for pleasures as opposed to pains, for feelings of hunger and thirst, and of heat and cold. Bodily feelings of tiredness, as of the legs, the feet, the arms, or the hands, etc., pangs of hunger, feelings of nausea, of heat and cold, of pain and pleasure, are private to the subject and are discernible by him, at definite places in the space of his sense-field, commonly but not necessarily within his visually or tactually perceived body. A feeling of pain or pleasure, for example, is usually discerned at or near the same place as a sensum of touch or pressure, of taste or smell. Usually then it is located within or at the surface of the subject's perceived body. But in the instance of the sensum of tingling experienced by the man with the amputated arm quoted previously, because tingling—akin to, if not actually, a tactual sensum—is usually accompanied by pleasure or pain, this must also have been located by him outside his visually perceived body. It could well be supposed that a tongueless man, whose appropriate gustatory nerves or brain areas were stimulated electrically, might experience a taste sensum, locally associated with pleasure or pain. This would be therefore necessarily external to his perceived body. It cannot be claimed that pain or pleasure, when these words have their present meaning, are ever locally asso-

ciated with visual or aural sensa. For if a bright light or a loud noise is associated with pain in a percipient then the pain is located in his head and not, where the visual or aural sensum lies, outside his head. Nevertheless, excluding visual and aural sensa, it would appear that pleasure or pain may be locally associated with all other kinds of sensa, including the kinæsthetic and may therefore be located either inside or outside the percipient's perceived body. Pleasure and pain are here considered to be sensa because they occupy space and are also private to the percipient.

To avoid misunderstanding it is necessary at this juncture to state that non-spatial 'feelings' are better called 'emotions' or are related to these. Anger, sorrow, crossness, surprise, astonishment, 'pleasure', 'pain', etc., are not sensa, but are either emotions, or are related to these. The distinction between emotions and sensa is that, although both are private to the subject, sensa are spatial, having position within his sense-field, whereas emotions are non-spatial, or at least he cannot discern them in the space of his sense-field. (They are both temporal, since they have position in the subject's time-sequence or history). Yet there is no reason why emotions, desires, and thoughts, should not occupy space of another kind since he who experiences them has position. This space may not easily be recognised as space by him, for reasons given later (p. 66). Feelings of 'pleasure' and 'pain' associated with the knowing of good and evil, beauty and ugliness, and of truth and falsehood, are likewise not sensa and for the same reason. Sensa alone are the sole inhabitants of any sense field. Feelings do, however, induce sensa, particularly within the region of the viscera.

It is sometimes supposed that such qualitatively different kinds of sensa as sights, sounds, scents, tastes and touches, not to say aches, pains, and other kinds of bodily sensa, must each require a qualitatively different sense-field for each person. Dual personality of the Jekyll and Hyde type also can exist and further even a normal man must be considered to change from moment to moment, although strangely enough retaining continuity of his

identity. Nevertheless if we consider a person at one moment only, when he may be supposed simultaneously to have sensa of several different qualities, he experiences himself as one person and one person only at that moment. It is therefore inferred that, being one person, he has momentarily, and at the everyday working level of consciousness, only one conscious kernel or body (later, Chapter IV, to be identified with his brain, which is not any visual, bodily, or tactual, "brain"* sensum, although the common notion of 'body', as contrasted with 'mind', arises from such sensa), which is situated where *he* is. Having only one body it would follow that he has only one sense-field associated with this, and containing all his sensa of every quality. In virtue of his unity, a person at the everyday waking conscious level at any moment, therefore, is inferred to have only one conscious body (*i.e.* brain), and to have, not several associated sense-fields, but only one; not several sensual spaces, but only one sensual space, in which are situated all his sensa whatever their qualities.

The data of perceptual events cannot be identified with postulated public external objects. Hence they may be private to the experience of a sentient being within perceptual events. Positive evidence in support of this privacy is given below by reference to mirror images. They also have the other qualities such as colour, noise, pain, cold, etc., and size, shape, motion, number, and generally of spatio-temporality, as are possessed by sensa. The data of perceptual events may in consequence be adjudged to belong to the general class of sensa.

To summarise: sensa include 'bodily feelings' of pain and pleasure, hunger and thirst, heat and cold, tiredness and nausea, etc., as well as the sensa corresponding to the five main senses. They are constituents of memory, dream, and hallucinatory events, as well as of perceptual events, and of experiential events induced by stimulation of the subject's appropriate nerves or brain areas.

* Hereafter *sensa* are denoted by terms in quotation marks: *e.g.*, "brain", "body"; *External objects or events* are denoted by unchanged terms: *e.g.*, brain, body. Where terms are used without this differentiation of meaning then this is denoted by single quotation marks; *e.g.*, 'brain', 'body', 'mind'.

The distinguishing features of sensa

The distinguishing features of all sensa are: (1) spatio-temporality, which comprises qualities of the Lockeian primary kind, (2) qualities of the Lockeian secondary kind, as colours, sounds, tastes, etc., (3) lack of perdurance, in that they can exist only so long as the sensual event exists in which they are contents, (4) privacy, in that sensa finally depend for their fugitive existence on the appropriate excitation of the subject of a sensual event and on his awareness of them, (5) no intrinsic orderly change following determinable laws, and thus no causative action on each other, (6) a complete lack of mental states or activities, such as thoughts and desires, hopes and fears, joys and sorrows, loves and hates.

The first two characteristics of sensa have been discussed sufficiently for our purposes, but the others require justification. *The lack of perdurance of sensa* and of all sensual events, except those which are perceptual, is common knowledge. The fugitive nature of dream images is often tantalising to the dreamer; the "pink elephants" and "rare snakes" of the inveterate drunkard disappear when he is sober; the images of memory are frequently difficult to conjure up and even more difficult to retain; whilst the visions of hallucination and trance vanish when these states cease. As regards perceptual events, when I close my eyes my visual sensa immediately disappear, the whole array to the furthest horizon, and only reappear when I reopen my eyes. Similarly when I stop my ears my aural sensa cease to exist and can only come into existence again when I unstop my ears. Visual and aural perceptual sensa, on this evidence, lack perdurance. There is no need to refer to other perceptual sensa, such as aches and pains, cold and heat, touches, tastes, and scents; except to say that they likewise are intrinsically fugitive and exist only within the equally short-lived perceptual events of which they are contents.

The privacy of a sensum and its final dependence on the subject of a sensual event is evident in all but perceptual events. I exclude any reference here to extra-sensory perception. Dream and

memory sensa are clearly private. Wordsworth's "daffodils" were his and his alone. The drunkard's "pink elephants" receive no verification of independent existence outside him, that is of public existence, either through touch by him, or through visual perception by other people, when they look in the direction indicated by the drunkard as being that in which the "pink elephants" are to be seen. On the other hand, the entire dependence of a perceptual sensum on the subject of the perceptual event, in which the sensum exists, seems doubtful at least, because the visual sensum has earlier been described as being produced through the excitation of the subject by light coming from an external object. Similarly all other perceptual sensa may be related to the excitation of the subject by external objects. Nevertheless, although in addition to a subject an external object appears to be necessary for the production of a perceptual sensum, this does not mean that the sensum is not private to the subject. There is evidence to the contrary. For example the mirror image of my hand, when this is placed before a mirror, namely, the visual sensum "hand", can not be visually perceived by other people when they look at the place where I say it is situated, that is, behind the mirror. The mirror-image sensum of this perceptual event is as private to me as are the drunkard's "pink elephants" to him. It is not easy to establish in a direct manner the privacy of all visual sensa because, as has been explained previously, they usually occupy at any moment, positions which appear to be identical with those of the postulated external objects, as detected by touch. This is owing to the comparative proximity of the external object and the subject and to the then relatively undeviating course of light and its high speed. It is only by considering visual sensa of the mirror-image kind, where the course of light travelling from external object to subject is deviated, that the private nature of visual sensa of all kinds is disclosed. Perceptual sensa such as aches and pains, hunger and thirst, touches, tastes, and scents, are undoubtedly private. The scent, which I have, of a rose is private to me. No other person can possibly share that content of my experience.

They may have similar experiences but the "scent" within their experience is not that of mine. Tastes and touches are likewise private. Aural sensa appear to be public but, owing to the finite velocity of sound, and following an argument similar to that already reproduced for visual sensa, it could be shown that aural sensa cannot be identical with the postulated public or external objects. It is therefore possible to assert that all sensa, perceptual and otherwise, are private.

That sensa generally follow no natural orderly sequence of change according to determinable laws and have no causative action on each other is clear when we consider the sensa of dreams and hallucinations, but is far from obvious when those of sense-perception are considered. In dreams a "man" may be "killed" at one moment and "come to life" an instant later with ready ease; a "football" may be "kicked vigorously" by a "man" and may 'refuse' to move in accordance with the laws of mechanics, either by not moving at all or by being lost in "the blue" from which it never returns to earth; the "fire" which destroys one's "house" leaves the house pleasantly untouched when one wakes and 'perceives' it the following morning.

In contrast with dream sensa, perceptual sensa are orderly and it is through man's observation and investigation of their orderly sequence that he is able to formulate the laws of physical science. These purport to summarise the behaviour of external (physical, public) objects. According to the present sensum theory they can merely summarise the representation of this behaviour, through the observed orderly sequence of perceptual sensa. The notion of causality arises, if at all, from what is merely its representative appearance in sensa. But *sensa in themselves are without any noticeable power of causation as has been indicated for dream sensa.* This can be shown to be true even of perceptual visual sensa where these are remote from their postulated related external objects. Thus I can put a finger of one hand through the space occupied by the visual sensum "hand", which is the mirror-image of my other hand, without experiencing the slightest obstruction to its passage, although the sensum looks as substan-

tial and impenetrable (causative), or almost so, as the direct visual sensum "hand" of my first-mentioned hand, the space denoted by the direct sensum being however impenetrable to such action. The first-mentioned perceptual visual sensum lacks substance or causative power. Similarly, a person could walk through the drunkard's "pink elephants" without knowing, because he would not experience the slightest obstruction to this passage. Sensa of all kinds including perceptual sensa, are extremely 'thin' and lacking in causative substance. Consequently they do not of themselves suffer orderly change according to determinable laws. According to the sensum theory perceptual sensa only appear to change in an orderly and 'law-abiding' manner, which gives the appearance of causation, because they represent external objects. These must be supposed to be in themselves causative and therefore orderly. Perceptual, like other sensa, have negligible power and substance and for all practical purposes may be deemed entirely lacking in these attributes.

There is no need to doubt the last characteristic of sensa, for it would be generally agreed that *sensa, even those representing men and women, are completely without mental states or activities, involving thought, emotion, and desire.* This does not necessarily signify that sensa are non-mental. Indeed it is fairly certain that they are mental. For instance, it would, I think, be generally conceded that dream and memory sensa are contents of the mind, because they are of the nature of figments of the imagination. Further, even the mental content of a memory event which is not sensual, is without mental states or activities. For instance, when I remember myself as a small boy, full of disgust and dismay, on falling from the surrounding wall of a pig-sty on to the back of one of the occupants, at feeding time on my uncle's farm, there is now no longer any of those feelings in 'the boy' I remember. Indeed, by reason of this being a content, it cannot be expected to possess them. Yet it would be agreed that such a memory-content is mental. Only the subject in any memory event, sensual or otherwise, can be expected to have mental states or activities. Thus sensa may be mental without having

mental states or activities. We may conclude that all sensa, being qualitatively similar to dream and memory sensa, are mental contents.

External events (objects): their existence

It seems difficult, logically, to prove, from simple and acceptable premises, the existence of causative external objects corresponding to sensa. But there is evidence which renders man's intuitive belief in their existence likely to be true in so far as it concerns sense-perception, but unlikely to be true for all the other kinds of sensual events such as dreams and hallucinations. In the first place it is only during sense-perception and not in sensual memory, dreams, or hallucinations, that man has been able to show that light, sound, and nerve-impulses, have finite speeds of travel and has been able to measure these speeds. This is the first item of evidence derived from the investigations of scientists whereby it follows, from the arguments already given, that the sensum is distinct spatio-temporally from something else, namely the postulated external object. This evidence, and scientific evidence generally, supports man's belief in the existence of external substantial objects, corresponding to the orderly sensa of sense-perception, but not to the sensa of other sensual events.

We have shown that the space and time of an external object is different from those of any corresponding sensum. But it appears that they are closely related since the tactual sensa of man's waking life can usually be regarded as veridical, that is, as providing true information of the existence of external objects occupying definite spatial positions at certain instants of time.

Man's belief in the existence of external objects—objects other than him—is basically related to his mass of bodily sensa and to two different kinds of touch experience. In one kind, as when I touch my chin with my finger, there are two tactual sensa, simultaneously occupying almost the same position in my sense-field, but distinguishable because of the experienced slight differences in position and in possessing different qualities of

cold or warmth, of roughness or smoothness, of hardness or softness. In the other kind of touch experiences, as when I touch the table with my finger, there is only tactual sensum within my sense-field. Both kinds of touch experience indicate a position in my sensual space which is roughly coincident with part of that indicated by my mass of bodily sensa or "body".

It is probably only gradually that a baby comes to know, through touch experiences of these two kinds and through his bodily sensa, (sight does not appear to be necessary, although it may facilitate the process of knowing, because the congenitally blind acquire this knowledge) that he has a body and that there are bodies *other* than his. Through apparently purposeless action he appears gradually to come to know that, in the dual touch experience, one sensum is related to one part of his mass of bodily sensa and the other sensum to another part. Later he finds that he can induce this dual touch experience by exercising his will and bringing the two parts of his mass of bodily feelings into proximity and this may be regarded as the dawn in him of the concept of *cause*. He gradually also comes to know that, in the single touch experience, the tactual sensum is related to only one part of his 'mass' of bodily sensa. Presumably by intuition or by rudimentary reasoning he comes gradually to understand that some body other than his, together with his body, has caused his single tactual sensum. Thus may be supposed to arise in him the concept of 'otherness'. Even a kitten appears to be able to acquire knowledge of this kind, for after several successful attempts to catch her 'tail', she appears to realise that it is not some 'body' other than her's, but that it is part of her 'body' and ceases this behaviour forthwith. A baby develops his notion of causation with reference to his power of moving 'other' objects as well as himself. Motion, that is to say change of position of sensa, and finally the orderly change of sensa in any way during sense-perception, may denote causation to the developing infant.

The basic test of the existence of an external object, which is causative and which is independent of and other than me, is that

of the induction of a single tactual sensum in my touch experience. I can experience such a sensum—a delusive sensum—in a dream and yet, because nobody else simultaneously would have a similar experience at that place and time, it would be inferred that the object which I 'touch' is not an external object, independent of me, although as the dreamer I should believe it to be so whilst I dreamed. Nevertheless I would maintain that I know when I am awake largely because of the continued orderliness of my sensa, and therefore this basic test of 'otherness' remains valid. In man's waking life his touch sensa are not delusive, but are veridical in that they reveal the existence of external objects. This primary test being valid, secondary confirmation of the existence of an external object can be obtained through a combination of visual with tactual sensa (to distinguish between delusive visual sensa, such as mirror images, and veridical visual sensa). These constitute my usual private source of knowledge of external objects having existence in the external world.

Man's belief in the existence of external objects includes his firm belief in the existence of other beings like him, but who are almost, if not quite, completely independent of him. He supposes that they have inner lives of their own, similar to his, and consisting of desires, thoughts, and emotions, but which he normally does not know immediately and directly as he knows his own inner life. Telepathy is ruled out of this discussion by the use of the word 'normally'. Man, in ordinary life, is never a solipsist. He believes in the existence of a society of men and women around him, of which he is a member. With these people, who induce in him visual sensa similar to those induced in him by himself, he believes that he is able to communicate by signs and movements, by behaviour, by language, and by art. This assumption or belief he holds in spite of his knowing, on reflection, that all his experiences, including all mental content, such as sensa, are quite private to him, and therefore consist only of him and not of anything other than him. His belief is sustained by the close qualitative similarity of his sensa, whether these are consciously known by him to have been induced in him by

himself in speech, writing, art, gestures, and movements generally, or on the other hand consciously known by him *not* to have been induced in him by himself. Apart altogether from his intuitive and quite unreflective assumption that other men and women exist, reflection enables him to infer, from experiences of sensa of the second kind, that they are caused in him by beings like himself since both he and they are equally capable of causing qualitatively similar sensa in him. Here again dream situations and hallucinations may provide similar sensual experiences, which however are delusive. There is no need to repeat the evidence for the existence of external objects. All that will be repeated here is that there is such evidence and that therefore I shall infer that external objects and other people do exist in addition to 'myself'.

From his belief in the existence of men and women and of external objects other than himself man has arrived at the concept of 'publicity' because the men and women at least, beings like him, can all know each other and other external objects also. Each man and woman, and each other external object would thus constitute a public object capable of being known by a multiplicity of knowers in a multiplicity of perceptual events. Each external object would be an object of common knowledge by many people. The reverse of this constitutes the usual test for an external object. That is to say, common knowledge as reported through the medium of 'language' by many men, or the attribute of common verifiability, is the usual human criterion of the independent and external existence of an object.

The characteristics of external events (objects)

An external object is supposed, according to the native belief of man the realist, to persist between periods of observation and hence not to depend for its existence on being observed or known. Evidence in favour of this belief is indirect. Each morning I have a visual sensum of my home as I leave it. The sensum is such as to give me daily the impression that I am knowing the same external object. I have no reason to suppose that the house

'vanishes into thin air', in between my acts of perceiving it, for my wife tells me—*a propos* of its advantages and disadvantages—that she still 'perceives' it even when I do not. Even so, this is not altogether satisfactory evidence for its independent persistence, as my wife's continued perception may of itself be maintaining its existence.

As a second item of evidence for the 'persistence' of an external object, I will consider myself as an external object for other people to know. Another man sees 'me' as a visual sensum, which is transitory, passing out of existence within him so soon as *I* pass from his immediate neighbourhood. However I know myself to persist as a thinking, desiring, feeling, being, beyond this time even though unperceived by others or by myself—as may be supposed to be possible if all bodily sensa as well as all other kinds of sensa were non-existent in my experience—so that I am open to his perception when next I 'present' myself to his gaze, say some hours later. (Sense-perception is only one way of experiencing or knowing myself, but it is the only kind for my knowing objects or events other than me. Sense-perception, or a perceptual event, is unlike other mental events because it is transient, whilst they are relatively permanent. I may know my own body, as I know other bodies, through perception of a sensum "body", but I know myself in addition as a thinking, desiring, feeling, being.)

Now the other man's visual sensum of "me" or of another "man" or "house", is always of the same fundamental qualities as already recounted (p. 29). So there seems to be no obvious reason to suppose that there is any basic difference between the external objects represented by these different visual sensa. If, then, *I* persist, in between acts of being observed or perceived by people, it is probable that the other man and the house also persist. Indeed the other man would inform me that he knows himself to continue to exist when unperceived, as I know myself to continue to exist when unperceived. In this manner an external object may be supposed to be persistent, whereas a sensum is relatively transitory. The latter depends for its existence on being

a constituent of a transient perceptual event, whilst the external object may be supposed to have an existence independent of any perceptual event. Since, however, I may be an external object for another percipient and because I am an *event of knowing*,—where *knowing means consciousness or active experiencing of all kinds*, and not just thinking or intellectual activity—any external object *may* possibly be an event of knowing *i.e.*, an external *event*. I shall in future designate all external objects, external events, though the term 'event' at this stage need not imply an event of knowing. A perceptual event may then be taken to be a more or less momentary act of conjunction of at least two 'external' events; hence its transitory nature.

Man, as a realist, assumes that external events (objects) undergo orderly change both during, and apart from, his perception of them; the laws of this change being in some degree determinable and conveying the notion of causation. I shall just mention here that the scientific positivists would deny the claim that scientific laws reveal cause and effect. For them these laws are merely statistical descriptions or summaries of observed behaviour patterns, from which it would follow that no predictions could be based on them, as would be implied in the notion of 'causation'. This viewpoint will be briefly discussed later (p. 165).

We have previously described the orderly change inferred from perceptual sensa, summarised in the laws of science, as *representing* the orderly change of the corresponding external events on being 'perceived'. The orderly change of external events when not 'perceived' is indirectly verifiable. If I were to leave some of the grey metal zinc (in excess) immersed in an aqueous copper sulphate solution (blue liquid) overnight, so that nobody perceived the system, then in the morning my visual sensa would reveal to me a colourless liquid (zinc sulphate solution) and a red metal (copper). A similar final state would be observed as a result of orderly continuous change if the system were continuously perceived, and it is therefore presumed that a similar orderly and smooth change must have occurred to have produced the overnight result, when the system was not observed. A

closer approach to confirmation of this conclusion may be reached through scientific investigation where the change of the system is alternately periodically perceived and unperceived. A graduated series of perceived states of the system showing orderly and gradual change between the acts of perception, approximating, (when the periods between the acts of perception are made sufficiently short), to continuous and orderly change can be obtained.

It will be convenient to summarise now *the main features which external objects are believed to possess* by any realist:—

1. they are spatial as well as temporal and occur in a space-time common to all external objects;
2. they are public because they are open to perception simultaneously by many observers;
3. they are more enduring than sensa, being able to persist during the intervals between periods of perception, and do not depend for their existence on their being perceived; and
4. they undergo orderly change both during, and in the intervals between, periods of being perceived, the laws of this orderly change being in some degree determinable and conveying the impression of causation.

This belief, in general, appears to be native in man and is the foundation of any creed of natural realism. Only if he is a direct realist will he identify the external object in whole or part with the sensum.

In this chapter I profess to have shown that, in sense-perception, sensa alone are immediately and directly *presented,* in the private sensual space-time of the percipient (subject), as mental transitory, non-causative, unsubstantial, and therefore intrinsically disorderly, private, data. However, perceptual sensa are believed, not without reason, to *represent* the relatively persistent, causative, substantial, and therefore intrinsically orderly, public external events (objects), in the absolute public space-time of the external world, which is probably qualitatively different

from, but is nevertheless closely related to, and is at least as extensive as, any private sensual space-time.

I agree with Professor Broad (*The Mind and Its Place in Nature*, Chapter 4, p. 181), that sensa constitute a new kind of entity but not altogether for the reasons which he offers. According to him, sensa are neither physical nor mental; being non-physical because, although spatio-temporal, they are not public like external or physical events (objects), and being non-mental because, although private they have no mental activities or states like mental events (subjects). The spatic-temporality of sensa cannot however be thought to be paralleled only by that of external or physical events (objects) but can also be paralleled by that (p. 66) of active minds or mental events (subjects). Thus sensa can be likened either to physical objects or to subjects (minds) as regards spatic-temporality. However, sensa differ qualitatively from subjects (minds) in being mentally inactive *and* from physical objects in being private. They can be regarded as a new kind of entity to be distinguished both from active minds or subjects and from public physical objects.

The present sensum theory obviously requires and will receive (Chapter IV) further clarification concerning the nature of the sensum and its relationships with the corresponding external event (object) and internal event (subject). In addition, before it can be further developed, the truth of epistemological dualism must be more thoroughly investigated by examining theories of direct realism. This follows in the next chapter and I am glad to express my indebtedness to Professor Lovejoy's book, *The Revolt Against Dualism*, in this connection.

CHAPTER III

THEORIES OF SENSE-PERCEPTION

Direct realism

The direct realist is not satisfied with any theory of indirect realism such as the sensum theory which has been propounded in the last chapter, for according to him if the external event (object) is not apprehended directly then it is never apprehended at all. Thus the nature of the external world would be unknowable and any statements about it nonsense.

William James, in his essay "Does Consciousness Exist?" saw that there was duality of a kind in sense-perception, namely that the sensum is not only "out there" but is also in some way "in the mind" of the subject. His solution was that one thing may be a member of two or more classes. "The puzzle of how the one identical room can be in two places is at bottom just the puzzle of how one identical point can be on two lines. It can, if it is situated at their intersection . . . 'The one self-identical thing' in one context is 'your field of consciousness', in another it is 'the room in which you sit'; and it enters both contexts in its wholeness, giving no pretext for being said to attach itself to consciousness by one of its parts or aspects, and to outer reality by another." He had, however, overlooked the fact that the identity of two things can only be admitted if their qualities are the same, and it has been shown in the previous chapter that the qualities of the mental datum (sensum) are quite different from those of the postulated external event. Therefore a sensum and the corresponding external event cannot be identical and this solution to the problem of sense-perception can only be regarded as inadequate.

Upholders of the Instrumental Theory of Sense-Perception agree that "the nervous system is an indispensable instrument for perceiving" but that "this harmless truism is consistent with any

theory" (Professor Laird, *A Study of Realism*, p. 30), and thus with the theory of the direct perception of external events. However, from the known finite speeds of light, sound and nerve impulses, it follows that sense-perception must be the last of a series of processes, which start at what we call the external event corresponding to the sensum and finish with the sensum, so that the latter cannot be identical in time or place with the former. If it is admitted that different percipients are capable of experiencing differences in the time, place, and quality, of their perceptual data, when they purport to be perceiving the same event; if the visual datum may be changed for one percipient, as is admittedly possible, by interposing coloured glasses, or a number of mirrors, or lenses, between him and the event perceived; and if the possibility of error in perception be admitted, then the instrumental theory of direct perception cannot be true.

Another argument of the direct realists, against the indirect realism of epistemological dualism such as the present sensum theory, is that since eventually the dualist, in sense-perception, apprehends the external event through the sensum, of what use is the latter? In other words, why not assume that perception is direct? Since the dualist must have both external event and sensum in mind to be able to contrast them, the critic maintains that the dualist has already surrendered to the monistic realist's position and that no sensum is necessary, but indeed that direct perception of the external event is possible. The answer to this criticism is that the present content or datum of a sensual *memory* event cannot possibly be the original pristine event, which is remembered, for this by hypothesis is not present. The pristine event must thus be known through a representative or substitute, which is not the event. Thus a dualistic theory of mediate knowledge is not only possible but necessary.

Some direct realists are of the opinion that epistemological dualism or indirect realism is damned by its history, which tends to show that to concede the representative and mental ('ideal') nature of the content of perceptual events leads inevitably to the conclusion that all is mental, and hence that the only certain way

to retain realism is to deny the mental nature of the data and to maintain that it is physical (external). The direct realist would therefore abandon the representative 'ideas' of the epistemological dualist. However, the evidence, physical, physiological, and psychical, points to a spatiotemporal and qualitative distinction between the datum of the perceptual event and the postulated external event, as has been shown in the preceding chapter. Epistemological dualism in one form or another, on these grounds, cannot be abandoned.

The 'new realists' believe that 'things are just what they seem.' But this is not naïve realism since the 'things' referred to are primarily not of the world of 'real being' or 'existence' but merely of the world of 'being' or 'subsistence', which is defined as including all actual or possible objects of thought. It thus appears to be possible to regard both veridical and delusive data as being 'objective'. Thus a veridical sensum might be identical with the corresponding external event if they are assumed to subsist merely in the world of being. Here they must be regarded as 'universals', without time and space. But in so far as a veridical sensum and its corresponding external event are 'real' things they are 'particulars' and each possesses its own time and space. Thus, in the real world of existence, the external event and the veridical sensum are distinct, in agreement with epistemological dualism.

The monistic realist must accept percepts (perceptual sensa) into the world of physical (external) events because for him any percept is the whole or part of the corresponding physical (external) event. As the contents of dream, hallucinations, creative fancy, etc., resemble percepts he must find a place for these also in the physical (external) world. This he has attempted to do in one of two ways. In the first way, that of neo-realists like Professor Alexander (*Space, Time, and Deity*, Volume II, pp. 216–217), these dream, etc., contents or illusions, are not additions to the real (physical or external) world, but "are perspectives of the real world as seen by a mind in abnormal condition. . . . Illusions are the real world seen awry or squintingly. The

world of illusions is the same as what we call the real world, but dislocated, its parts taken from their proper places and referred amiss. That dislocation is the mind's own work. Illusion is due to the intrusion of the mind's own idiosyncrasies into the apprehension of reality. But it does not create but only rearranges what is already there. Thus all the materials of illusory percepts are real, and, if the world of reality is taken wide enough, the percept itself is a perspective of the real world, and is just as objective and non-mental as any other percept; and if it is a percept of a physical thing it obeys the laws of physics and is not merely non-mental as being neither mental nor physical, but is physical."

From the last paragraph it appears that full membership of the physical world which is accorded to the 'percept of a physical thing' is not accorded to 'illusory percepts.' But the latter cannot be given any kind of membership of the physical world for there is no reason to suppose that an 'illusory percept' exists, as a particular, when nobody for example is dreaming of it. Therefore it cannot be supposed to undergo orderly change according to the 'laws of physics' when unobserved since it does not then exist. Professor Laird (*ibid.*, p. 63) also thinks that illusions or images "are precisely what they appear to be, spatial, temporal, and physical, yet without a home in the perceived order of space and time." For example if the drunkard expects the snakes, which he 'sees', to strangle him, he is mistaking the kind of meaning possessed by images for that possessed by percepts. Thus images are not 'physical' as are the 'percepts of physical things' and if the image as a whole is "without a home in the perceived order of space and time" it follows that its component parts cannot have such a home and thus cannot be identical with the true physical (external) events supposed by the monistic realist to be directly apprehended in sense-perception. Images or illusions cannot be physical.

The first way having been found untenable there remains for the monistic realist the alternative of putting the 'wild' data or images or illusions into the physical world as additions to what is already there. This means that they would actually occupy, at

any moment, the space which they appear to occupy. Even so their behaviour is still disorderly and wild, and is not in accordance with physical laws. They cannot, in other words, be regarded as physical. Thus for these and other reasons given in the previous chapter and, in direct contradiction to the monistic realists, no sensum, veridical or delusive, can be identical wholly or partially with the corresponding external event (object). Sensum and 'object' are distinct.

Mr. A. N. Whitehead's theory of sense-perception

The upholders of the theory that may be called Objective Relativism, are direct realists and so believe that perceptual content is 'objective' and is either the whole or part of an external object. However, they reject the epistemological monism of the monistic realists and maintain that the data of sense-perception are 'relative to percipient events', in agreement with Special Relativity Theory.

The germ of this kind of relativity is contained in Locke's theory of sense-perception and especially in his notion of secondary qualities. According to Locke, in sense-perception, an independently existing body interacts with the knower and produces a kind of mechanical impression, which constitutes the knowledge that the knower experiences of the body. "Bodies produce ideas in us . . . manifestly by impulse, the only way which we can conceive bodies operate in," (*An Essay concerning Human Understanding*, Book II, Chapter 8, Section 11). Primary qualities "do really exist in bodies themselves"; secondary qualities "are, in the bodies we denominate from them, only a power to produce those sensations in us" (*ibid.*, Section 15). Locke's view then is that, although there is a dyadic relation between primary qualities and the perceptual datum, which is here also the external event (object), so that for example an object literally has such and such a position and shape, yet that there is a triadic relation between secondary qualities, the perceptual datum (object), and the observer, so that a rose is not red in itself, but is only red as perceived by, or with respect to, an observer.

Objective relativists infer from modern relativity theory that both kinds of Lockeian qualities; primary as well as secondary; shape, size, duration, etc., as well as colour, scent, touch, etc., must be accorded the status of Lockeian secondary qualities but with a difference. In short, objective relativism maintains that if an external object or 'event' has a certain character or quality *by virtue of a certain relation*, then it 'objectively' or truly has that quality.

Objective relativists deny the "bifurcation of nature" as Professor Whitehead has said "into two systems of reality which, in so far as they are real, are real in different senses," one being "nature apprehended in awareness" which "holds within it the greenness of the trees, the song of the birds, the warmth of the sun" and one inferred as "nature which is the cause of awareness." He denies the concept of nature as bifurcated into 'causal nature and apparent nature', into 'individual experience and external cause'. He attributes the error of dualism or bifurcation to 'the fallacy of simple location'. In its place we must substitute 'the ultimate concept of organism' involving the relational way of regarding space and time which must be regarded as being indissolubly united together within space-time, as the foundation of our scientific interpretation of nature.

The organic view does not imply the essentiality of all relations in the sense that 'the part is for the whole' as in organisms. Some are contingent relations. The latter in contradistinction with the former are relationships "which might be otherwise, without change of the particular individuality of the factor" or portion of nature. "In other words, the factor would be what it is even if the contingent relationships were otherwise." The 'physical field' is 'luckily atomic' and involves a breakdown of essential relatedness and because of this we can isolate our problems. Otherwise every statement would require a detailed expression of all the facts in nature. Thus it appears that, even for Whitehead and the objective relativists, there is a compromise between the 'essential relations of organism' and the external or 'contingent relations' corresponding to the classical and non-relativistic notion of 'simple location'.

For him the concept of 'essential relations' is not merely the inclusion of the part within the whole, but is a sort of inclusion of the whole within the part. "In a certain sense everything is everywhere at all times . . . the event which is the bodily life unifies in itself aspects of the universe" (*Science and the Modern World*, p. 114). He would have scientists follow the intuition of the Romantic poets such as Wordsworth and develop a sense of "that mysterious presence of surrounding things, which imposes itself on any separate element that we set up as an individual for its own sake" (*ibid.*, p. 103). However "The mere fusion of all that there is would be the nonentity of indefiniteness. The salvation of reality is its obstinate, irreducible, matter-of-fact entities, which are limited to be no other than themselves. Neither science, nor art, nor creative action can tear itself away from obstinate, irreducible, limited facts" (*ibid.*, p. 117). "Everything which is in space receives a definite limitation of some sort, so that, in a sense, it has just that shape which it does have, and no other, also in some sense it is in just this place and no other," and similarly as regards time. "An event is there and not here (or here and not there); it is then and not now (or now and not then)"; it "is a fundamental property of events" that they "can only be in one place at a time" (*The Principles of Natural Knowledge*, pp. 62, 65). Since 'events' are the true substance of nature any qualities which they possess must have the same kind of individuation and situation; and 'simple location', far from being denied as a law of nature, is clearly maintained.

He sometimes denies 'simple location' not to events but to qualities, or as he terms them 'objects', since these are 'universals'. As they are 'ingredient into events' and so become 'particulars' this view cannot be maintained. He distinguishes between 'sense-objects' and 'perceptual objects'; "a sense object, such as the colour red is not a true adjective of its situation, since there is always a necessary reference to a percipient event" (*The Principles of Relativity*, p. 33). An 'adjective' is a "character which an event has for itself alone" or, in other words, is a Lockeian primary quality. 'Perceptual objects' are true adjectives

or Lockeian primary qualities of the events which they qualify. They "never transcend relativity or centredness in some form" but "transcend relativity to human beings." This distinction between 'perceptual objects' and 'sense-objects' is precisely the dualistic distinction between the qualities of the external event (of our sensum theory) and of the sensum within the experience of the subject. But this distinction is directly opposed to the denial of the bifurcation of nature into causal nature and apparent nature, supposedly maintained by the objective relativists.

The present sensum theory differs from that of objective relativism in maintaining: (i) that nature *is* bifurcated into 'causal' and 'apparent' nature, into qualitatively distinct 'events' (external and internal) and 'sensa'; (ii) that the qualities of sensa, which are necessarily relative to the internal event (subject), comprise all those previously included under Lockeian primary and secondary qualities and include also those of electricity, magnetism, mesonism (page 77) and gravitation; (iii) that the qualities of external events (objects) are primary in the Lockeian sense since they are non-relativistic with respect to any perceptual event wherein they are represented, and are distinct from those of sensa; (iv) that although there is no all-embracing sensual space-time, yet that there *is* a universe uniting all events, and parts of this may be closely represented in any private sensual space-time; and (v) that there are no 'objects' or universals subsisting in a world of permanence of 'pure being' and which are 'ingredient into events'. On the contrary, permanence or constancy is here supposed to be maintained in the universe, a world of existence or 'becoming', with its necessary flux, *because* of this flux, as is explained in Chapters IV and V. The constancy of any event is indeed fundamentally related to the Planck Constant of Action. (Appendix I.)

Mr. Bertrand Russell's theories of sense-perception

Up to this point the discussion has shown that the common-sense view of realism, according to which the data of perceptual events are thought to be wholly or partially identifiable with the

external or physical event (object), is untenable, because of the demonstrable spatio-temporal and qualitative distinctions between perceptual data or sensa and external events. We turn now to the theories of Mr. Bertrand Russell and find this viewpoint confirmed. He has attempted to show that mental events may be identified with parts of the physical world, so that so-called 'matter' may be one with 'mind' (but see later p. 55). He has gone about this in at least two ways.

In the first way, he considers that it is a mistake "to regard the 'real' table as the common cause of all the 'appearances' which the table presents (as we say) to all observers." A table or other external event (object) is never directly perceived so why assume it to be present as the cause of the appearances. Instead, by a table is meant "the set of all those particulars which would naturally be called 'aspects' of the table from different points of view." That such aspects exist where there is no observer is evidenced by the fact that photographs may be made. The number of such appearances must approach infinity. There is no 'real' object other than the group of appearances "related to each other approximately according to the laws of perspective." Thus "what we call a material object is not itself a substance, but is a system of particulars analogous in their nature to sensations and in fact often including actual sensations amongst their number. In this way the stuff of which physical objects is composed is brought into relation with the stuff of which part, at least, of our mental life is composed." (*The Analysis of Mind*, p. 108.)

In agreement with epistemological dualism he assumes that different observers have simultaneous sense data which are not identical, and, combining this with the relational theory of 'space' he concludes that the data of each percipient are in 'private spaces'. However, he postulates 'one all-embracing perspective space' containing all the private spaces. Without this there would be a "breach of continuity in passing from what I perceive to the outside particulars dealt with by physics." For this theory there is the difficulty of defining the locus of a physical object, which is simply a set of 'aspects' scattered through space. Also, since

photographability is the test of the presence of an 'aspect' of an object at a given place, the only place where an object is not is where it is commonly supposed to be. The group of appearances "is hollow; when we get sufficiently near its centre it ceases to have members" (*The Analysis of Matter*, p. 211). There must also be allowances made for irregularities in the 'laws of perspective' to include reflection, refraction, and generally speaking "the distorting influence of the medium" (*Analysis of Mind*, p. 136).

This theory of 'physical objects' verges on phenomenalism. The introduction of the "appearances" which do not appear, but are only possibilities, give the object its 'objectivity', 'physicality', or 'reality'. Since 'appearances' exist in large numbers in the all-embracing perspective space there does not appear to be "any dubious reasoning from observed effect to unobservable cause, but . . . merely an application of the principle of continuity." He considers that this theory accords well with the modern description of 'matter' in terms of electromagnetic fields. "What we call one element of matter—say an electron—is represented by a certain selection of the things which happen throughout space-time, or at any rate throughout a large region. . . . A piece of matter is only a convenient grouping of occurrences which extend throughout space-time, and it is these occurrences, not matter, that physics accepts as ultimate." Also "modern physics reduces matter to a set of events which proceed outward from a centre. If there is something further in the centre itself, we cannot know about it, and it is irrelevant to physics." ("*Perception and Physics*", in *Mind*, N.S. 1922, pp. 478–9.) Like Whitehead, he would include colour and sound in the physical world; "the sensation that we have when we see a patch of colour simply is that patch of colour, an actual constituent of the physical world, and part of what physics is concerned with." (*Analysis of Mind*, p. 142.)

This first theory whereby mind is supposed to be unified with matter must be adjudged not to have been successful for the following reasons: (1) if the definition of 'physical object' be con-

sistently applied to our own bodies, heads, and brains, and to the media which are supposed to deviate rays of light, then absurd consequences follow, (2) it could only apply to the identity of sensory content with 'physical objects' and not to non-sensory mental activities, such as emotions, thoughts, and desires, and (3) even non-perceptual sensory mental content such as 'images' cannot be identified with 'physical objects' for images cannot be "included among the aspects which constitute a physical thing or a piece of matter" (*Analysis of Mind*, pp. 301–302), since otherwise you play havoc with the order of the physical world.

His second hypothesis would justify the inclusion of both non-perceptual and perceptual sense-data within our heads, which are supposed to exist in the physical world. We cannot, as we did on the first hypothesis, identify sense-data with at least part of the 'physical object'. "What is called a perception is only connected with its object through the laws of physics; its connection with the object is causal and mathematical; we cannot say whether or not it resembles the object in any intrinsic respect, except that both it and the object are brief events in space-time." (*Philosophy*, p. 149). Also "in places where there are no eyes or ears or brains there are no colours or sounds, but there are events having certain characteristics which lead them to cause colours and sounds in places where there are eyes and ears and brains" (*Philosophy*, pp. 157–8.) Thus, to quote Lovejoy, the second hypothesis is "another variety of the form of dualistic realism known as the generative theory of sensa—a variety distinguished by the extent of its agnosticism about everything *except* immediate data, sensible or other, and therefore by the greatness of the contrast which it admits between perceptual content and metempirical reality." (*The Revolt Against Dualism*, p. 226.) Complete bifurcation is avoided however by the statement that "our percepts are inside our heads" and therefore, like them, are in physical space.

Mr. Russell's theory of sensa is different from the present sensum theory and from that of Professor Broad (*The Mind and its Place in Nature*, p. 181), according to whom sensa "*cannot* be

spatio-temporal parts of physical objects. No doubt they are really extended; they really last for so long; they really have certain shapes, sizes, colours, etc.; and some at least stand in spatial and temporal relations to each other. But they are not, in any plain straightforward sense, in the one Physical Space in which physical objects are supposed to be; and between pairs of them which are connected with different observers there are no simple and straightforward spatial or temporal relations. The objective constituents [sensa] of perceptual situations are, on this view, particular existents of a particular kind; they are not physical, as we have seen; and there is no reason to suppose that they are either states of mind or existentially mind-dependent. In having spatial characteristics, colours, etc., they resemble physical objects, as ordinarily conceived; but in their privacy and their dependence on the body, if not the mind, of the observer they are more like mental states." I have previously (Chapter II) commented on these views concerning the nature of sensa.

Four principal reasons are offered by Mr. Russell for stating that percepts are situated in our heads: The first is that "whoever accepts the causal theory of perception is compelled to conclude that percepts are in our heads. . . . We cannot suppose that, at the end of this process, the last effect suddenly jumps back to the starting-point like a stretched rope when it snaps." (*Analysis of Matter*, p. 336.) From this argument it does not follow that percepts must be in our heads even though they may be, because the assumption which is made that otherwise the perceptual sensum (percept) must be identical in position with the starting-point of the process, namely the causal external object, is unjustified, as has been shown in the last chapter. His second reason is that the notion "that what we see is 'out there' in physical space is one which cannot survive" when we grasp "the difference between what physics supposes to be really happening and what our senses show us as happening." This argument merely shows that *if* percepts are 'physical objects' they cannot be the same objects as those assumed by physicists to be present in physical space. His

third reason is that the certainty of our knowledge of the immediate sense-datum implies that this is in the brain. However it is known that many events occur in a man's brain without *his* knowing them consciously and so the occurrence of an event in a man's brain will ensure no guarantee of direct apprehension. Finally he argues that any other view introduces into nature "a preposterous kind of discontinuity." The ordinary account of visual perception is that "a physical process starts from a visible object, travels to the eye, there changes into another physical process, causes yet another physical process in the optic nerve, finally produces some effect in the brain, simultaneously with which we see the object, from which the process started, the seeing being something 'mental' totally different in character from the physical processes which precede and accompany it" (*Philosophy*, pp. 140–141). But such a view of perception is 'miraculous' and 'incredible'. The remarks regarding the discontinuity and miraculous nature of the 'ordinary' interpretation of sense-perception appear to be reasonable. Yet the argument that the perceptual sensum must therefore be in the brain is not clear although it may well be true that the sensum *is* in the brain. Much would depend on what is understood by 'brain' and 'percept' (sensum).

He states that percepts are "just what they are, whatever physics may say" (*Analysis of Matter*, p. 338) and "What we perceive is part of the stuff of our own brains, not part of the stuff of tables, chairs, sun, moon, and stars" (*Philosophy*, p. 281). With the last statement one would agree, if by 'brain' is meant brain and not "brain" (see footnote, p. 28). The most obvious objection to the theory is that quite clearly my percepts or perceptual sensa are mainly outside my head. He thinks to overcome this objection by postulating two kinds of head, a perceptual head and a physical head, my sensa lying mainly outside the former but inside the latter. The perceptual head lies in my private perceptual space whilst my unperceived head lies in public physical space. He usually but not always supposes that perceptual space is not a part of physical space, which is opposed to the

standpoint of his previous main hypothesis where 'private' spaces were parts of the overall 'perspective' space. He would not agree to the concept of perceptual space-time since "in the world of percepts, the distinction between space and time does really exist and space does really have certain properties which relativity denies to physical space". (*Analysis of Matter*, p. 338.) This question has been discussed in Chapter II (see also Chapter V).

To return to the question of the 'physical' head. Is it a head at all in the usual sense of the term? Apparently so, since he writes that all events of my experience "together, in physical space, occupy a volume smaller than my head, since it certainly does not include the hair, skull, teeth, etc." The head mentioned here must be the 'physical' head since it contains all my mental events. Now perceptual sensa are precisely as big as they appear to be and my perceptual space at any moment is just as big as it is perceived to be. My 'physical' head apparently therefore is very large, but since it is imperceptible it is impossible to say how far away are my hair, skull, teeth, etc. The only reason apparently for accepting this strange, large, 'physical' head, where perpetual space is allowed to be part of physical space, is that otherwise we cannot find a head into which my percepts can be placed. If we accept the second possibility, regarding physical and perceptual space-times, namely that the latter is not part of the former, then percepts cannot be contained in my 'physical' head, and percepts (sensa) must be qualitatively distinct from 'physical objects' which is a result quite contrary from what he intended to effect by his second main hypothesis.

In spite of this he argues that the view that "mind and matter are quite disparate" has, historically, rested upon "a notion that we know much more about matter than we do, and in particular upon the belief that the space of physics can be identified with the space of sensible experience." When, therefore, "the separation of physical and sensible space is logically carried out" the "groundlessness of traditional views about mind and matter" is demonstrated and Descartes' metaphysical aberration is corrected (*Philosophy*, p. 239). Clearly however the more you separate the

the space of the physical world and sensory experience, the more you affirm the disparateness of 'matter' and sensory content. Thus this second hypothesis does not solve the problem which it purports to solve.

More recently, in *Human Knowledge* (p. 246), he states that: "while mental events and their qualities can be known without inference, physical events are known only as regards their space-time structure. The qualities that compose such events are unknown—so completely unknown, that we cannot say either that they are, or that they are not, different from the qualities that we know as belonging to mental events." As will be gathered shortly, one would agree with his assertion about mental events (these being assumed to be the same as our 'events of knowing'), but not about 'physical' events.

Sense-perception: historical notes

In this chapter we have been discussing the question as to whether any realistic theory of sense-perception can dispense with the notion of the representative 'ideas' of the seventeenth century philosophers, Descartes, and Locke. We have argued that both representative 'ideas' or sensa, *and* external events, must exist for any realistic philosophy and that they must be distinct entities. However, the serious difficulties, inherent in this position of representative perception, according to which mind can only know what is mental and thus all knowledge of external events (objects) must be mediate or indirect "by the intervention of the ideas it has of them" (Locke, *An Essay concerning Human Understanding*, Book IV, Chapter 4, Section 3) are obvious. For if ideas are the only 'objects' immediately and directly present to the mind, how can we be assured of the "conformity between our ideas and the reality of things," where the 'things' referred to are external events (objects).

Berkeley, fastening on to one main aspect of the difficulties, denied the existence of matter, lying 'behind' the representative ideas or sensa, and intrinsically unknowable. Thus the representative ideas or sensa constitute the only matter that exists. "It is

indeed an opinion strangely prevailing amongst men, that houses, mountains, rivers, and in a word all sensible objects, have an existence, natural or real, distinct from their being perceived by the understanding . . . yet whoever shall find in his heart to call it in question may, if I mistake not, perceive it to involve a manifest contradiction. For, what are the forementioned objects but the things we perceive by sense? and what do we perceive besides our own ideas or sensations? . . . In truth the object and the sensation are the same thing." (*The Principles of Human Knowledge*, Sections 4–5.) For Berkeley objectivity or reality remains because the sensations represent the reality of habits of volition in the mind of God. Hume, dealing with the other main aspect of the difficulties, demolished the self or the knower, as a person having persistent identity. He concluded from our inability to produce the distinct impression from which the idea of self is derived that we have no idea of self. "For my part, when I enter most intimately into what I call *myself*, I always stumble on some particular perception or other, of heat or cold, light or shade, love or hatred, pain or pleasure. I never can catch *myself* at any time without a perception, and never can observe anything but a perception." (*A Treatise of Human Nature*, Book I, Part 4, Section 6, paragraph 3.) We then have merely a flux of sensations and ideas, pure sensationalism or phenomenalism, unless we admit the binding power of the 'association of ideas' and this appears to be inadequate as a means of knowing the universe.

Kant used the word 'phenomena' for 'sensations' or 'ideas'. But he was not a phenomenalist, since he supported the representative theory of sense-perception. Thus, unlike Berkeley, he holds that: "phenomena are only representations of things (noumena) which are utterly unknown in respect to what they are in themselves." (*Critique of Pure Reason*, Book II, Part Second, Chapter II, Section II, paragraph 22.) Also, unlike Hume, he maintains the notion of the existence of the self for he states that "The internal sense, by means of which the mind contemplates itself or its internal states, gives, indeed, no intuition of the soul as an object;

yet there is nevertheless a determinate form, under which alone the contemplation of our internal state is possible" (*ibid.*, Part First, Section 1, paragraph 2).

Phenomenalism

Phenomenalism is a variety of Direct Realism. Phenomenalists believe that there is no matter lying 'behind' sensa, but that matter is nothing more nor less than groups of sensa. Matter or reality is therefore known directly and not by way of representatives. The great advantage of phenomenalism is that it would remove any doubt about the existence of matter, for we should know this directly as sensa, and its properties would be those familiar to us in sensa. Whereas, on any representative theory of sense-perception, the very existence of matter may be thought doubtful, and its properties could never be known directly.

There are, however, grave disadvantages. The first concerns illusion. Why do the drunkard's snakes not strangle him if, as would appear to follow from phenomenalism, his visual sensa "snakes" also constitute the real snakes? The answer returned by the phenomenalist would be that the visual sensa alone do not constitute the real snakes but that sensa of 'strangling' must be associated with the visual sensa to constitute the 'real' snakes. The drunkard's sensa or appearances are thus 'unreal' or illusory and his expectations remain unrealised. Similarly, those visual sensa such as mirage-mirror-and dream-images are unreal or illusory because they are not associated in an orderly way with other sensa, gustatory, tactual, aural, etc., as are visual sensa normally. For a phenomenalist, what is 'real' consists of orderly groupings of appearances or sensa, whilst what is 'unreal' consists of disorderly or 'wild' appearances which give rise in the subject to false expectations. In this manner the difficulty may be overcome.

The second disadvantage concerns the permanence or constancy of physical or material or real objects. Now I have already recounted the notorious transience of sensa and clearly this provides a big difficulty for the phenomenalist. He overcomes this,

in a way comparable to the method of photographability adopted by Mr. Bertrand Russell. This is to postulate the possibility of sensa which are hypothetical, but which could be realised under suitable conditions. Under other circumstances some of these could have been realised in the present, in addition to the actual sensa of the present. Some may be realised in the future, and some may have been realised in the past, all within human experience. It is these possible sensa of the past, present, and future, which, in association with the orderly groups of actual sensa of the present, may be said to constitute matter and to give it permanence or reality. With J. S. Mill, the phenomenalist would define 'matter' as 'the permanent possibility of sensation'.

Causation is a third problem for phenomenalists. Sensa, in themselves, as we have seen (Chapter II) are inert and without any power or energy, and they cannot cause changes, as is commonly assumed for matter. What then is causation for the phenomenalist? Hume gave the answer. In the same way that Berkeley regarded matter, not as mysterious unknowable 'substance' but as directly knowable sensa, so Hume regarded causation not as a mystery bound up with substance but as any directly observable relationship of regular and habitual sequence of sensa. The work of scientists, which can be supposed to be the discovery of the laws of orderly change in the material world, then becomes the revelation by them of the orderly spatio-temporal patterns of sensa.

In this manner phenomenalism seems to rise superior to these three disadvantages. However it does not cater for the second quality associated with the concept of causation, that quality of inner experience which I have when I exercise my will, as in thought or imagination or in physical activity. Here I am aware of causation not through the regular, habitual, patterned, sequence of sensa, which are devoid of this quality, but through a single act, in my direct and innermost experience, of personal will and power. There is evidence for the existence of other people like me (Chapter II). We may all be causes of effects in ourselves and also in others. It seems arguable that the phenomenalist's causa-

tion is merely representative of this, which it would then be possible to regard as substantial or real causation (see p. 103).

Neither is phenomenalism convincing in its interpretation of the permanence of a material object. The 'possible' sensa required for this, are as hypothetical as the material object or external event of dualistic representative theories. Indeed, looked at from this viewpoint, the group of orderly sensa, actually present, is itself only representative of the material object and the theory is in part a dualistic and representative theory of sense-perception. Moreover the exceedingly transient nature of sensa of all kinds provides a most unsatisfactory basis for the explanation of the untold permanence of the material world.

In addition to these objections to phenomenalism, there are the difficulties of the finite velocities of light and sound to overcome, in any explanation which it can give for the act of sensation. Again, what is the photon—the electron—the atom? These singly are unobservable through sense-perception and therefore can not be expected to exist for the phenomenalists unless they allow *all* the corresponding sensa to be hypothetical. They would surely agree that the photon, the electron, and the atom do exist. But this is tantamount to their agreeing with a wholly dualistic theory of sense-perception so that phenomenalism itself is invalid.

The views of Eddington

Eminent modern philosophers such as Mr. Bertrand Russell (p. 51) and physicists such as Eddington follow Kant in some degree. Eddington asserts that the external counterpart of our sensa "must be of a nature beyond our apprehension, and science can make nothing" of them (*The Nature of the Physical World*, p. 246). Since, however, every physical object is a "schedule of pointer readings" attached to some unknown background, and the only background of which man has any insight is his own consciousness, why not attach the schedule to something of the nature of mind. "It seems rather silly to prefer to attach it to something of a so-called 'concrete' nature inconsistent with

thought, and then to wonder where the thought comes from. We have dismissed all preconception as to the background of our pointer readings, and for the most part we can discover nothing as to its nature. But in one case—namely, for the pointer readings of my own brain—I have an insight which is not limited to the evidence of the pointer readings. That insight shows that they are attached to a background of consciousness. Although I may expect that the background of other pointer readings in physics is of a nature continuous with that revealed to me in this particular case, I do not suppose that it always has the more specialised attributes of consciousness. But in regard to my one piece of insight into the background no problem of irreconcilability arises; I have no other knowledge of the background with which to reconcile it" (*ibid.*, pp. 251–252). He continues: "There is nothing to prevent the assemblage of atoms constituting a brain from being of itself a thinking object in virtue of that nature which physics leaves undetermined and undeterminable."

If the terms 'atoms' and 'brain' were to mean atoms and brain, and not "atoms" and "brain" I must agree, because Eddington, as an event of knowing (subject) or brain, is referring in this passage to his own "brain" sensum, even though it must be a mirror-image, and to the corresponding external event (object), his own brain. Therefore, I cannot agree in this special instance with Lovejoy when he says (*The Revolt against Dualism*, p. 271) "when we speak of a 'background' we mean something which is, so to say, on the other side of the percept; we presuppose three factors in the situation, *viz.*, the physicist's consciousness, the given perceptual content, and a *tertium quid*, which underlies the content, is the cause or condition of the presentation of that particular bit of content to his consciousness, and is the member (of this trinity) which would remain if *his* consciousness, and therewith its immediate content were eliminated. And we have no evidence at all that the third factor is of the same nature as the first." For all other sensa, but the "brain" of the observer himself, this argument would hold, but not for this particular sensum.

The sensum "brain" here denotes the seat of the observer's everyday waking consciousness (Adrian, *loc. cit.*), his brain, so that this might conceivably be the *tertium quid* (object) of the situation and *also* the event of knowing (subject).

Consciousness is not merely consciousness at one level. There are many levels, as for example in waking life, in sleep, hypnosis, and anæsthesia, so that, if we widen the meaning of the term as we shall, to include all levels, then 'consciousness' will be regarded as the whole range of the height and depth of processes of knowing. This would then include the lower levels of consciousness, which we know to persist between periods of existence of the higher levels, and which presumably support and help to build up, with the aid of stimuli from outside, these higher levels. Then the *tertium quid* and a person's consciousness could be identical—the person's brain—and the latter would disappear if the *whole* of the former disappeared and *vice versa*, which would be contrary to Lovejoy's assertion, but only in this special instance. It is however, as Eddington saw, just this special instance, which provides the clue giving us the hope that, on this basis, we may solve the general problem of the relationship between science and psychology, that is to say between perceptual sensa, representing external events in the external world on the one hand, and an event of knowing or person, in whose sense-field the perceptual sensa are presented, on the other.

As a result of the discussion of the last two chapters, it is contended that a man never has direct knowledge of the public external world of external events (objects) but merely has representative knowledge of this world, through perceptual sensa in his private sense-field. Scientists therefore can never hope, by their own efforts, to attain to a truer understanding of the 'laws of the universe', which relate to the orderly sequences of change and the nature of events in the universe. They can only discover the 'laws of science' which relate merely to the *representation* of the orderly sequences of change and the nature of events, through the simulated orderly sequences of change and the nature of perceptual sensa in the sense-fields of individual

scientists. Modern physicists, because of the difficulties which they have had in interpreting the behaviour of the "fundamental particles", the "photons", "electrons", etc., are generally agreed that they are dealing with what are often called phenomena, but which are here termed sensa, and which are here believed to be mere representatives of real events.

CHAPTER IV

EVENTS AND SENSA: PSYCHOLOGY AND SCIENCE

Introduction to the relationship between events and sensa

If, in spite of the spatial extension of the visual sensum "brain" representing a man's brain (mind), we disallow the spatial extension of his mind, on the grounds of the evidence of direct experience, only in so far, however, as thoughts, desires, and emotions, do not populate the simultaneously experienced sense-field, then we cannot be sure of the truth of the argument that, because the visual sensum "body" has spatial extension in the sense-field, therefore the body itself has spatial extension of the sensual space kind. For, granted that no common-sense interpretation of sense-perception, involving the spatial and temporal identification of a sensum with its external object, is possible, we have no evidence, through direct presentation in conscious experience, of the sensual spatiality or non-spatiality of the body. It might well be that, if there were such direct presentation, the body, like the brain, would be non-spatial, in so far as it would not inhabit the sense-field. Then both brain (mind) and body would be sensually non-spatial because neither would occupy a man's sense-field.

There is also no distinction to be made between 'mind' and 'body' in respect of the divisibility of 'body' and the indivisibility of 'mind', because we know of dual and multiple personality (mind); of the dissociation of mind to a mild extent in ordinary people and to a greater extent in insanity, and of the process of integration of a human mind which must therefore, in some way, be capable of existing in parts. Sherrington has said "each one of us is in some sense not one self, but a multiple system of selves. Yet how closely those selves are united and integrated to one personality. Even in those extremes of so-called double person-

ality, one of their mystifying features is that the individual seems to himself at any one time wholly either this personality or that, never the two commingled. The view that regards hysteria as mental dissociation illustrates the integrative trend of the total healthy mind" (*Mental Hygiene* 1923, p. 16). However, Professor Allport in his book *Personality* has related the value of dissociation to personality.

We cannot, then, accept Descartes' sharp antithesis between mind and body *either* on the grounds of spatiality, where this refers to the kind of spatiality presented in a man's sense-field, *or* on the grounds of divisibility. Both may be non-spatial, in that they do not exist in the space of a man's sense-field, but there appears to be nothing to preclude them both from being spatial in a different kind of space; both *are* divisible. Thus the true qualitative distinction is not, as was drawn by Descartes, between body and mind, but is between (1) *sensa*, which are not capable of desires, emotions, and thoughts; and which are spatio-temporal in that they occupy a man's sense-field, (2) *internal events* (*subjects*), which *are* capable of desires, emotions, thoughts; and which are only not spatio-temporal, in that they do not occupy the space-time of a man's sense-field; and (3) *external events* (*objects*), or 'bodies', which are usually considered to be spatio-temporal but, in view of the present argument, possibly only as internal events are spatio-temporal.

The Cartesian dualism of mind (subject) and of body or matter (object) has long been misleading because it has appeared so inescapably true. The seeming irreconcilability of the two has made it difficult for men to view the universe as a unified whole. It is believed that our arguments have shown that the scientist's matter must be replaced by his perceptual sensa, as Berkeley revealed originally. Then the previous unbridgeable dichotomy would disappear (see p. 75). The broad, essential, qualitative, differences between sensa and external events (objects) and also between sensa and internal events (subjects) has, I hope in each instance, received sufficient elucidation.

The task that remains is to find, if possible, the more

detailed relationships between them. To avoid dangerous ambiguity I shall use the term 'external' and not 'physical' as meaning 'existing independently' (independently of the event of knowing) when applied to the events which are being known. In its common use to-day the term 'physical' could be applied as correctly to perceptual sensa *and* to their corresponding external events. Even Professor Broad (*The Mind and its Place in Nature*, p. 207), who makes a clear distinction between sensa, internal events of knowing, and external objects, though not using these terms, assumes the existence dyadically, in the last-mentioned, of the so-called 'physical' factors (he terms them primary qualities) of electricity and magnetism. In spite of the seeming power of electricity and magnetism this assumption cannot be allowed, for no man has direct and immediate knowledge of the qualities of external events through his sensa, but only of perceptual sensa representing these same external events. No man can 'see through' his sensa directly to the external event beyond. Electricity, magnetism and mesonism (p. 77) therefore will be regarded as factors of the observer's sensa ('matter') and sense-field ('gravitation') only. They must be triadic because they are always relative to an internal event (subject). They can only be *representative* of more fundamental factors remaining to be discovered and constituting external events.

The word 'physical' like the word 'matter', has bemused men's minds for many years and has produced the confusion just indicated. Both will be used very sparingly and only where strictly necessary hereafter. The fundamental factors of external events, corresponding to the factors of sensa, can only be discovered indirectly, if at all.

The characteristics of internal events (subjects)

The solution of the main problem which we have set ourselves, namely, the relationship between external events, perceptual sensa, and internal events, has previously been mentioned in connection with Eddington's work (pp. 59–61), and it will now be discussed more fully. First, any event of knowing is centred

at a certain place and time and is therefore part of a space-time, which is not that of any sense-field, because sensa are incapable of mental activity and are thus qualitatively different. As an internal event consisting of states or activities of knowing, I am yet spatio-temporal because I have position in some kind of space and time. I am here and now, having my experience of knowing, and not there and then. My desires and emotions, my flights of thought, apparently without space and time, and of imagination, through supposedly indefinitely large space and time, are undoubtedly centred in my known definite spatial position at any moment of my time history. Thus, having position and time, I exist in a space-time which, however, cannot be my sensual space-time.

The two kinds of space-time are qualitatively different. This qualitative difference would, at least partially, explain my not recognising, as space, the space in which I undoubtedly have position and of which, therefore, I must be a constituent. This partial explanation is completed by realising that I am so little extended, so highly localised in my brain (mind), as would be indicated by my mirror-image sensum "brain", that it would be difficult for me to resolve the spatial differences of position of my mental processes even if they were stationary, but seeing that they are processes and therefore also involve continual motion, the difficulty apparently becomes an impossibility. On the contrary, individual sensa, being comparatively stationary, relative to one another (although their parts when examined microscopically and in detail, by the scientist, are inferred to be in incessant motion), and being widely dispersed in a three-dimensional space which is apparently of indefinitely great extent, can readily be differentiated from other sensa, and therefore are readily apprehended as existing in space. Mind, having mental activity, as distinguished largely from mental content such as sensa, must however in itself be spatial for the reasons given, as is confirmed by reflecting that this must be so if mind in any way is to apprehend space of any kind. Spatio-temporality, involving spatial extension and temporal duration—extension generally—is thus an essential

quality of internal events (subjects). From the discussion (Chapter II) of the spatio-temporality of sensa, veridical and delusive, it would appear that spatial and temporal extension is also an essential quality of external events (objects). This more fully exposes one cardinal error of Descartes in distinguishing between mind as being non-extended and body as being extended.

Although an internal event (subject) and an external event (object) may both be regarded as spatio-temporal, yet unless they are qualitatively the same, they cannot exist in the same space-time. We must, therefore, next examine whether or not they *are* qualitatively the same, bearing in mind that we have the additional difficulty to overcome, that external events are only known within internal events through their representatives—sensa. Nevertheless, the realist believes that external events have certain qualities and we shall attempt now to compare these, as described in Chapter II, with those of internal events.

External events are supposed to undergo orderly change both during, and in the intervals between, periods of being perceived, the laws of this orderly change being in some degree determinable and the change conveying the impression of causation. This supposition of the realist we have supported by what we consider to be adequate evidence in Chapter II. We now consider the question: do events of knowing (subjects) display the same properties as external events?

My reasoning processes, which I know to be freely effected in large measure by myself and are directed by a combination of at least volition and intellect, together with some emotion, do normally follow an orderly course of events. In other words 'cause and effect' are inherent in those freely exercised processes of reasoning, where there is little if any necessary reference to the external world as represented in me by perceptual sensa. These processes are orderly in much the same way that the sequences of change in the external world are orderly, as interpreted from the appearance of orderly change in representative perceptual sensa. By 'sequences' here I do not intend to imply that 'cause' is antecedent to 'effect' but that there are orderly sequences of

changes in events. Cause and immediate effect may indeed best be regarded as reciprocal and contemporaneous (see p. 103). The laws of reasoning, of 'cause and effect' in the realm of pure thought, are also in some degree determinable and are capable of being formulated in systems of logic and mathematics. Further, these largely conceptual processes are not dependent for their existence on being 'perceived', as processes within the brain, by an observer (subject) or by the thinker himself as subject. Neither is there any reason to suppose that ordinary visual sense-perception, in this meaning of the term, of the conceptual processes of a brain uncovered and open to observation, would induce them to become disorderly.

We may then say that internal events (subjects) are qualitatively the same as the indirect realist's postulated external events (objects) in existing and in undergoing orderly change independently of their being sense-perceived; the laws of this orderly change being in some degree determinable and conveying the impression of causation. But with conceptual thought there is more than the first quality, namely that of *orderliness* associated with the concept of causation; there is also the second quality, that of *the experience of will and power* in the known freedom of thought or conception, which is possible to the thinker, and in the *direct* and immediate presentation of his own conceptual processes to himself. We shall defer consideration (see p. 155) of what the 'himself' is—it has been referred to already in connection with Descartes, Hume, and Kant—that is to say, as to whether there is a pure Ego or not. In the same way that an event of knowing—an internal event—such as a man, could only apprehend space and time by having space and time in himself, so the notion of 'causation' that is, of will and power and of order, in the external world could only possibly be gathered by, or conveyed to, an internal event (subject) having 'causation' in his own nature.

An internal event consisting of conceptual processes, of desires, and of emotions, is capable of persisting without being perceived by other events of knowing, as has been explained earlier. The

brain of a man, the locus of human conceptual processes and of all higher levels of consciousness, is indeed rarely perceived, yet these processes are known to exist. They must therefore exist without depending in any way on being perceived. It also appears that an event of knowing (subject) is more enduring than a sensum, because a sensum is a temporary constituent of the subject, *In all these respects an internal event (subject) is qualitatively the same as an external event (object).*

The problem of consciousness

It is, however, of vital importance for the development of our argument, to attempt to assess the degree of qualitative similarity of internal and external events, and this cannot be disposed of so summarily. The real difficulty is that the "fundamental particles" of the world of science, the "photon", the "electron", the "meson", the "proton", the "neutron", and so on, although too minute singly to be experienced as visual sensa, must, if they could be so experienced, be accounted on the sensum theory, to represent external events (objects), namely the photon, the electron, the meson, the proton, the neutron, etc. Now a "human brain" sensum as experienced by a scientist is inferred by him to consist of these "fundamental particles" in association. Therefore, from the sensum theory, it would follow that human consciousness consists of the real association of fundamental particles in the brain. But consciousness comes and goes, whereas the brain, when represented or 'perceived' at different times as the sensum "brain", remains to all appearances, largely the same. What happens during a trance, sleep, hypnosis, and anæsthesia? The brain, during sleep appears, through the sensum "brain", much as it is during conscious life, and yet, during deep sleep, consciousness of the everyday waking kind has departed.

The basis of the solution to this problem is, as has previously been asserted, that 'consciousness' is a term commonly used in a loose way. It will be held to mean integration, together with its opposite, dissociation, of processes of knowing. There are

different levels or grades of integration even at what we have called the everyday waking conscious level. The levels of integration or consciousness, required for the mental experiences of intellectual or æsthetic or religious genius, must be considered to be very different from those of the usual consciousness of mankind and these again from those of dull-witted persons. These last levels of integration or consciousness must also be different from those of men during sleep, trance, etc., and these again must be different, depending on the depth of sleep or trance, etc., and will differ for different men. 'Consciousness' then will be taken to be a term covering the integration and dissociation of events of knowing (subjects) at many levels varying at least from the rarer heights of genius to the depths of deep sleep, hypnosis, anæsthesia and so on.

For internal events, during 'waking life' and sleep, etc., different levels of consciousness are regarded as being achieved reversibly through processes of dissociation (or disintegration) and of integration. When sleep, etc., intervenes, consciousness of the higher levels breaks down reversibly, but integration at various other lower levels may be supposed to remain. Reversible integration of some kind holds also for external events (objects). This can be gathered from the representative perceptual sensa dealt with by science, where the reversible integration or union of the vibratory—or wave—systems of "fundamental particles" into "atoms", of "atoms" into simple "molecules", and of simple into complex "molecules" is well known. Each "event" such as an "atom" has several definite 'wave-functions' corresponding to quantum energy differences or different and discrete energy levels (see *e.g.*, Heitler, *Wave Mechanics*, p. 31). It will be supposed that a similar wave-system (of several different and distinct energy-levels), which will be designated a '*proper wave-system*, (where 'proper' means 'peculiar to'), exists for *every* individual or event, however large and complex the event may be. The reversible integration of the proper wave-system or consciousness of an internal event would then be paralleled by the reversible integration of the "proper wave-system"

of a perceptual sensum, representative of the external event. The 'proper wave-systems' of perceptual sensa involve the reversible integration of "photons" with "particles" such as "electrons", "atoms", "molecules", etc. These changes induced by the photons are incapable of direct sense-perception by scientists and can only indirectly be inferred by them. That is here supposed to be why the "brain" sensum during sleep appears to be much the same as it is during 'waking life'. Nevertheless closer examination does reveal considerable differences of "brain" rhythms under these different circumstances. (Adrian, *The Physical Background of Perception*, Chapter 5.) That is to say, different "brain" wave-systems, or at least different wave-functions of the same wave-system, which may be supposed to correspond to different discrete or quantum energy levels can be related to different mental conscious levels of the brain. This constitutes most important scientific evidence in support of our general hypothesis (p. 74).

Reversible integration or consciousness will thus be supposed to vary from that of the 'heights' of human genius to that of the 'lowest depths' of a fundamental particle, such as an electron, or proton, both man of genius and fundamental particle being events of knowing. It is in this way that it can be supposed that events of knowing (subjects) are qualitatively the same as external events (objects) in that whilst it is possible for both to be disintegrated yet both are relatively permanent, integrated processes and so both may have consciousness or be processes of knowing at varying levels. This would reveal more fully the other cardinal error of Descartes in distinguishing between mind as thinking (or better as knowing) substance and 'matter' as non-thinking (non-knowing) substance.

To summarise *the qualities of internal events:*

1. they are spatial as well as temporal, and the space which they occupy is not sensual;
2. they are more enduring than sensa, being able to persist independently of perception;

3. they undergo orderly change independently of being perceived; the laws of this orderly change being in some degree determinable and the change exhibiting both the main qualities of causation.

Hypothesis concerning the relationship between external and internal events

The difficulty, associated with the apparent sameness of the human "brain" (perceptual sensum) when observed over long periods and the thereby inferred permanence of the human brain (external event) in contrast with the relative transience of human consciousness (internal event), from which it might be inferred that the human brain cannot be the human consciousness, has been shown to be capable of being removed. This follows from the argument that consciousness may have many different levels ranging from that of the waking life of man to that of an electron or proton and from the definition of consciousness as a reversible process, involving both the integration and disintegration of processes or events of knowing. For scientists know that scientific objects (perceptual sensa) *e.g.*, "atoms" and "molecules" may not only be disintegrated but also may be integrated from simpler "particles" and that they have 'proper wave-systems'. Scientific objects on the basis of the sensum theory, represent corresponding external events (objects) *e.g.*, atoms and molecules, which therefore also may not only be disintegrated but may be integrated from simpler particles and have proper wave-systems. In discussing the relationship between external and internal events, the final step to be taken, which is thought to be reasonable in the light of the qualities enumerated above, exhibited by both external and internal events, and in view of our elaboration of the meaning of 'consciousness', is that the processes integrated (or disintegrated) in any external event, are supposed to be processes of knowing (consciousness at some level) like those of any internal event. This is the initial statement of *the hypothesis* which was mentioned in the first chapter as being the object of our search, the hypothesis which

would conjoin man's knowledge of the external world with that of his own internal world.

Before proceeding with this hypothesis, however, *a serious objection to it* must be considered. Whilst many might be prepared to accept the proposition that 'any psychic or internal event may also be external, from another's viewpoint', yet perhaps few would at first agree that there is good evidence that '*all* external events are also psychic'. It could be contended that, from the observed movements of sensa, most, but not all, external events are wholly mechanical and do not display any trace of that purposive adaptiveness which is the mark of mentality. This, interpreted, would mean that living organisms exhibit purpose and mentality but that so-called 'inanimate' objects do not, since they appear to behave wholly mechanically.

I think that this opinion is mistaken and for the following reasons. *First* there is considerable evidence (see Chapter VI) that there is no qualitative distinction between living and lifeless individuals. For example, both kinds of individual are capable of spontaneous movement, and inorganic equally with organic autocatalysts are capable of assimilation of food, of growth, and of reproduction under suitable circumstances. *Secondly*, it seems that an atom of, for instance, nitrogen, as a constituent of a man's brain, is essentially the same as another atom, which is, say, a constituent of an atmospheric nitrogen molecule. No essential difference between them has yet been disclosed by scientific investigation. In other words the former atom does not appear to possess an *additional* 'substance', mind, which it *would* possess on the hypothesis implied in this objection and which is alternative to the one presented here; a 'substance' which would be denied to the atom of atmospheric nitrogen.

The *third* reason is as follows: the main purpose of any event (individual) is here supposed to be the maintenance of its existence and its own self-fulfilment (Chapter VIII). Minor purposes may be supposed to be contributory to the manifold of the main purpose. The adaptiveness required can only be expected to be commensurate with the complexity of the

main purpose of an event, as determined by, and as expressed through, its constitution or structural functions (Chapter VII) which may be relatively simple or complex. That required for the continued existence of simply constituted individuals such as electrons can only be expected to be relatively simple, because of the extreme simplicity of *constitution*, and the consequent extreme simplicity of variability of constitution (function) possible for different electrons. These electrons are presumed to be different because they are at different phases of their life periods (Chapter V) and may also be associated with slightly different energy quanta. The expectation is realised in the small range of variability of their relatively simple and small changes of behaviour, when the environment changes in the same way, for different electrons. That is to say different electrons (the simplest inorganic events) *do* exhibit variation of behaviour when subject to the same conditions. This variation, at this, the lowest level, is interpreted (as are the varied movements of sensa corresponding to living organisms and to mankind) to be signs of adaptiveness. But its simplicity is related to the simplicity of variability of constitution and thus to the simplicity of constitution and purpose of the electrons. The simplicity of adaptiveness of the electron is to be compared and contrasted with the greater variation (adaptiveness) of the more complicated behaviour changes of different individuals, of the same species of living organisms, when the environment alters in the same way for all of them. Adaptiveness appears generally to be proportionate to the complexity of constitution and of purpose of the individual.

For these three reasons it is considered that the difficulty raised by the objection to the hypothesis has now been resolved sufficiently to permit us to proceed. *The hypothesis is that: all events (objects and subjects) are psychic or are 'events of knowing'.* This implies (*a*) that all events exist in the same absolute space-time, of which the space is not sensual, but must be closely represented by any sensual three-dimensional space; (*b*) that all events are both public and private.

Thus the external and internal worlds would be of the same

fundamental nature and no bridge (see p. 64) would then be required between object and subject. This, in itself, cannot provide the synthesis for which we are looking, the synthesis of science and psychology, the reason being that the world of science would not be the public external universe inhabited by events, but would be the private internal sensual world of each scientist (subject) and inhabited by his fugitive perceptual sensa. The world of science would only be representative of the public external world. According to the hypothesis it is this electromagnetomesonic world, this mental sensual world, which we thus have to relate to man's supposedly inner world; which, however, is considered now to be also a member of the one public universe of events of knowing. Here we have reached the true meaning, as it affects the required synthesis of science and psychology, of the terms 'external' and 'internal' mentioned in the first paragraph of the opening chapter. On the hypothesis we have reached the somewhat inverted result, that science has to do with the images of the scientist's own 'internal' private world or sense-field, and that psychology has to deal with the events of the 'external' public universe and also with that event which is the scientist's innermost (body) self.

Although this would provide for the meaning of 'external' and 'internal' with reference to science and psychology, the position is not quite so simple as this might make it appear and for this reason. As an internal event I merely know myself, so far as this is possible, and hence I cannot extend my knowledge beyond myself; but the perceptual sensa within me represent events in the public universe, and would enable me to know them and the universe as it is in itself (at least in outline) if I could but interpret the sensa and, through them, the 'known' events aright. Thus in spite of what I have said of the 'internality' of the world of science, it would be the main means whereby knowledge of the external public universe can be attained. The right interpretation of external events, *ex. hypothesi,* is that they are events of knowing. Our main problem, that of the synthesis of science and psychology, therefore, will be to trace in more detail, but even

so only in broad outlines, the relationship between perceptual sensa in the world of science and events in the universe, the world of psychology.

The relationship between sensa and events: between science and psychology

The initial plan to be adopted in attempting to achieve our objective of linking together science and psychology was outlined in the first chapter. Following this plan the start was made from the certain existence of an event of knowing—myself. Sense-perception was then discussed in some detail as one of my means of knowing, the only normal means whereby I can obtain knowledge of the external world, tactual sensa of a certain kind having been recognised by me as revealing the existence of events other than me, namely external events. This was followed by the further discovery based on that of tactual sensa, that perceptual sensa of all kinds also represent external events of what is an orderly external world containing other men and women. Then from the qualitative similarity of 'myself' and external events, it was found possible to suppose that every event is both internal and external, depending on the viewpoint, and is an event of knowing.

So much for the first part of the plan; the second part will involve taking advantage of the fairly sure knowledge, so far as it goes, afforded by the perceptual sensa of science. In the light of this we shall proceed, in the third part, to consider the less sure knowledge which man has of psychology. We shall attempt to relate this more closely to scientific knowledge. Thence will be derived a link between psychology and science. Later, we shall endeavour to find, from a more detailed development of this link, some confirmation for it, and so widen the basis of our understanding of both psychology and science. Finally, we shall attempt to clarify, in some measure, man's position in the universe.

What has emerged with reasonable certainty in Science during quite recent years, as interpreted on the basis of the present

sensum theory, is that the inhabitants (perceptual sensa constituting so-called 'matter') of the sense-field, and the sense-field itself (later to be identified with the gravitational field), that is, the inhabitants of the world of science, are composed of three prime factors, namely electricity, magnetism, and mesonism. The existence of electricity and magnetism is well-known by everybody, but that of mesonism is little-known outside the ranks of the nuclear physicists. Adequate reasons for regarding it as being equally as prime as the other two factors must therefore be presented if this view is to be generally acceptable. Moreover the claims of gravitation to be as prime a scientific factor as electricity and magnetism—the common assumption—cannot be overlooked.

'Mesonism' is the term here applied to a new sort of scientific factor, recently discovered in connection with those fundamental particles called mesons which are intermediate in mass between electrons and atoms. Mesons are to be found in cosmic rays and within the nuclear particles called nucleons, which are protons and neutrons. The method employed here, of deriving the term 'mesonism', is similar to the method of derivation of the names of the other two prime scientific factors. Just as the property thought at first to be peculiar to amber (elektron) was termed electricity, and the property thought at first to be peculiar to the lodestone, of the town and district of Magnesia in Asia Minor, was termed magnetism, so now the property thought at present to be peculiar to mesons and particles constituted of mesons (*i.e., all* events more complex than mesons) is termed 'mesonism'. For the analogy to be complete, the presence of mesonism in "events" simpler than "mesons", namely "electrons" and "photons", would have to be demonstrated, but this is assumed in what follows. The presence of the other two prime scientific factors, namely, electricity and magnetism, in "electrons" and "photons" is well established.

In the meantime, evidence for the prime character of mesonism, as being clearly distinguishable from electricity and magnetism, will be revealed by quoting Professor L. Jánossy (*Cosmic Rays*

and Nuclear Physics, 1948, p. 122), "one may suppose that the nucleons carry a peculiar kind of charge, different from electric charge, and that these charges act upon each other by means of a field which they give rise to. The charge carried by the nucleons may be called 'meson charge' and the field produced by a meson charge may be called the meson field. The meson field does not act directly upon an electric charge nor does an electric field act upon a meson charge. *The two kinds of fields and charges are entirely different in nature.* Nevertheless the meson field obeys laws very similar to those obeyed by the electromagnetic field.... The meson field can ... account for the short-range forces acting between nucleons in an atomic nucleus." From this passage (my italics), which reflects the general view in physics, it appears undoubted that mesonism is qualitatively quite distinct from electricity. It may also be inferred that mesonism is as distinct from magnetism, for otherwise the mesonic field would have been recognised as being magnetic. Mesonism, like electricity and magnetism, is also seen to be associated closely and intimately with the bodies of fundamental "particles". Indeed it appears to be even more concentrated in and near the body of an "event" than is electricity for its range is shorter, whilst electricity in its turn appears to be more concentrated in and near the body of an "event" (*e.g.*, an "electron") than is magnetism, its range being the shorter. For these reasons mesonism is here thought to be a prime scientific factor.

The reason for ruling out gravitation as a prime scientific factor is that the gravitational type of field shows a very marked contrast from the other three types. Whereas they are relatively powerful and of short range, it is relatively exceedingly weak and of enormously long range. Whereas they are capable of close and certain *identification* with individual fundamental scientific "particles", gravitation is not so capable of this. The gravitational type of field appears only to be capable of close and certain identification with larger, massive events. It is the field associated with 'matter' as is made clear in Einsteinian gravitational field theory in which appear two sorts of conjugate tensors, namely the

gravitational potential and the tensor of gravitating matter. Whereas electricity, magnetism, and (mesonism), may display two kinds of polarity, and both attraction and repulsion, gravitation never displays any obvious polarity and attraction only. It is not necessary to suppose that gravitation ever exhibits repulsion —see the *Red Shift Phenomenon*, p. 134.

The gravitational field is best interpreted as a secondary and *not* a primary field (Appendix III). It is here regarded as the undifferentiated *field* complex of the other three kinds of field, just as so-called 'matter' is regarded as the undifferentiated *body* complex of the other three kinds of factor. These three kinds of field are then primary, and the factors, electricity, magnetism, and mesonism, are the prime scientific factors. Thus they entirely constitute the undifferentiated complex body (matter) of any "event" or sensum, and also the undifferentiated complex field (gravitation) of the "event". Gravitation is hence regarded as a secondary and *not* a prime factor. It would be seen to have a relationship with either electricity or magnetism which is different from the relatively simple and direct mutual relationship between these two factors. This would be in keeping with the known obscurity of the former relationship. It would also be consistent with the difference between the electromagnetic field and the gravitational field. Whereas the former is characterised in Clerk Maxwell's Theory by six functions, the latter is characterised in Einstein's Theory by ten functions. It is indeed very probable that, just as the magnetic and electrical fields can each be characterised by three functions in electromagnetic field theory, this is also true of the mesonic field since the electromesonic field would equally, with the electromagnetic field on our hypothesis, be characterised by six functions. (See also Schroedinger, *Nature*, 1944, *153*, 574.) The existence of only three prime scientific factors, electricity, magnetism, and mesonism, will be regarded as being reasonably sure (see also page 81). More than this is not needed, in order to develop the broad implications of the hypothesis that the universe consists of events of knowing, represented as perceptual sensa within me—an event—and to proceed along

the route which has been mapped-out. We shall, therefore, proceed to the next stage, that of psychology.

The grave disadvantage in psychology to-day, is that there are no sure foundations or basic principles for the systematic or rational understanding of the problems involved. The approach is thus always necessarily arbitrary and empirical, and the results obtained are so complex and confusing that it seems impossible to obtain from them firmly established generalised basic relationships. As Professor Allport has written (*Personality—A Psychological Interpretation*, p. 235), "The suspicion with which many natural scientists view psychology arises in part from their belief (entirely correct) that the elementary processes of mind have not yet been identified. Not that psychology has neglected the search for basic units with which to work. It has embraced hopefully many possibilities: faculties, ideas, instincts, reflexes, sensations, images, affects, factors, dimensions, and others—but the shifting of the lists, according to the predilections of the various investigators, has prevented a common meeting ground. Partly as a result of this failure to agree there has set in a reaction against the search for 'mental atoms'. The doctrine of the *whole* has won popularity. Yet the search for units has not in fact been abandoned. Only a shift of conception regarding the nature of the elements has occurred. Psychic atoms are denied, but psychic *structures* are affirmed, and these structures turn out to obey certain principles of organisation, and to be composed in turn of substructures, discoverable through the process of orderly analysis. And so even in its modern configurational phase, psychology is engaged as ever in the same difficult search for unit structures. For without some guiding hypothesis concerning the most suitable level of analysis, only wavering and ambiguous results can be achieved."

As has been noted previously in connection with space and time, and with causation, any event, which is always an event of knowing and consists of body and field, must have in its nature qualities, which enable it to apprehend the qualities of its sense-field. Thus the body of any event, which by hypothesis is the

body of a subject or person, will be supposed to have three prime psychic factors corresponding to the prime scientific factors in the sense-field. There cannot be less than three *prime* psychic factors in any of the events represented in a person's sense-field, for otherwise he could not distinguish so many as three *prime* representative and scientific factors in his sense-field. It is not necessary to suppose that there are more than three prime psychic factors in events, for, if there were a fourth, there seems to be no reason why it should not be represented as a fourth prime scientific factor in the subject's sense-field. That there are only three prime scientific factors will therefore be regarded as evidence that any event has neither more nor less than three prime psychic factors, which the three scientific factors of the corresponding sensum represent in a subject's sense-field. That there *are* only three prime scientific factors receives confirmation later (Chapter v and Appendix iii) because it is possible, from this assumption to achieve what has not previously been possible, the picture of the wave-motion and the wave-particle nature of an individual scientific "fundamental particle". Thus there will be supposed to be three prime psychic factors corresponding to the three prime scientific factors.

The adjective "prime" is employed here because none of the prime scientific factors is convertible into either of the others nor can it be subdivided into other factors. As they are supposed by hypothesis to represent the three psychic factors, these also must be prime factors in the sense that, when we have reached them, we have reached the lowest possible stratum of 'essence' and cannot analyse or subdivide them further. In this sense they will be regarded as the true psychic 'elements'. They must, however, always be integrated within a unit or event of knowing, as is inferred from the scientific "proper wave-system" which is the integration of the three prime scientific factors in the scientific unit—"photon", "electron", "atom", etc.—representing the event of knowing. The prime psychic 'elements' or factors must be constitutive factors of all psychic structural units and not the units themselves, in the same way that the corresponding prime

scientific factors are not any scientific "fundamental particles" or structural units, but are incorporated as factors in these units, such as the "photon", the "electron", the "meson", the "nucleon", the chemical "atom", etc.

The term 'factor' used here, both for psychic and for scientific factors, has a different meaning from that given to it by Allport (*ibid.*, p. 246), who considers that factors are independent elements constituting, in different proportions, all persons, much as the "photon", the "electron", and the "neutron", amongst other "fundamental particles", are supposed by the scientist to constitute all chemical "atoms". From our hypothesis and from the evidence of the prime scientific factors, any prime psychic factor could *not* be a structural unit in itself because, like any prime scientific factor, it would not be able to exist alone, but only in association with the other two factors, to form the essential fundamental structural atoms of an active event of knowing (mind). From this explanation also it would follow that a prime psychic factor is not any kind or sort of 'intelligence factor' as this term is commonly understood by psychologists.

Replies to criticisms of a factorial basis for psychology

Before proceeding to consider what the three prime fundamental psychic factors may be, answers must be found to criticisms of any hypothesis involving psychic factors. Four objections to a factorial psychology raised by Allport (*ibid.*, p. 244) are: (1) "The initial assumption of factor analysis . . . is open to challenge. Is it reasonable to assume that all people (or even those belonging to one 'type') do in fact possess the same basic constitution of personality?" (2) "A second difficulty arises in the naming of factors. . . . It seems easier and more fashionable to defend an abstract symbol than to argue boldly for such substantial elements as *will, perseveration, oscillation, social withdrawing, emotionality,* and *masculinity.* And yet, if this modern version of faculty psychology has virtue at all, it must lie in its ability to identify the true and fundamental components of personality which it set out to find. Up to now it has proved

difficult to translate the confident products of mathematical derivation into an equally self-assured language of theoretical psychology. In brief, factors often seem remote from psychological fact, and as such they risk the accusation that they are primarily mathematical artifacts." (3) "Another ground for disagreement lies in the assumption that *independent* factors are the desideratum of any theory of elements. Not only are all men supposed to have precisely the same basic elements in their personalities, but in each life these elements are to be regarded as independent of ('freed from the influence of') all other elements. Such an assumption is highly artificial. So interwoven is the fabric of personality that it seems almost impossible to think of any patterns that are wholly unrelated to others." (4) "Finally, it should be pointed out that no reconciliation is possible between the doctrine of *functional autonomy* . . . and the doctrine of factors. According to the former, the course of individuality is one of greater and greater divergence from the relatively standard pattern of infancy. The dynamic sub-structures of which a personality is composed are unique integrations formed in the individual course of experience and heredity. As each sub-structure develops it becomes a system of energy *sui generis*, obtaining, as Tolman has said, a 'strangle hold' in its own right. Now there may be a few *primary* strangle holds in the science of wrestling, but in the science of personality it is quickly discovered that the strangle holds in each life are unique. The factorial approach mistakenly assumes that they are uniform, though varying in weight."

My reply to these objections to a factorial psychology will be based on the hypothesis which involves the representation, in sense-perception, of all events (psychology) by sensa (science). The reply to the *first* objection then is, that it is as reasonable for me to state that all events or persons possess three prime psychic factors as for the scientists to state that all scientific 'objects' possess three prime scientific factors; to the *second* that I shall name the three prime psychic factors and not represent them by mathematical symbols, and that they will be very much more

substantial than the three corresponding prime scientific factors; to the *third* that, in much the same way as the three prime scientific factors may be conceived to be inextricably woven into any scientific 'object', so the three prime psychic factors must be regarded as inextricably interwoven and integrated into any and every event, and so, although the factors are prime, they may yet 'influence' each other, as for example the electrical and magnetic factors are known to do in scientific objects; and to the *fourth*, that because each scientific object is wholly constituted of the same three prime scientific factors as all other scientific objects, but yet is unique even within one scientific species (type), therefore, on the basis of our hypothesis, there seems to be no reason why each event (person) in a similar manner should not be unique, even though composed like all other events of the same three prime psychic factors. Generally, then, it is considered that objections to this kind of factorial theory of psychology may be overcome.

The identities of the three prime psychic factors

We now come to the question: *What are the three prime psychic factors?* They must fulfil three conditions, *first*, they should be obviously major factors of the human, waking, conscious, mind; *secondly*, they should be prime factors in that they cannot be mutually converted one into another; and *thirdly*, they should also have properties which enable them to be recognised in their scientific representatives: electricity, magnetism, and mesonism. The third condition provides a check on the responses which we provide to the first and second. To reply to the question: *the prime psychic factors* are here considered to be Plato's original factors of the human psyche or soul; namely (1) *volition* or *will*, (2) *intelligence* or *reason*, and (3) *emotion* or *'feeling'*. Each of these psychic factors fulfils the three stated conditions. Of the first condition it need only be said that each is obviously a major factor present in human consciousness, whether it is or is not one of the three prime psychic factors which we seek. Further, I cannot see how, granted three factors and three factors only, Plato's

choice could be improved on, at least for the satisfying of the first condition. As regards the second condition, this would appear to be fulfilled since volition, as in stupid obstinacy or in blind desire, has not the qualities of reason, nor can ecstatic emotion be mistaken either for volition or reason or be supposed to be mutually convertible into either of them, nor they into each other. However, since they are inextricably inter-woven or integrated in the unity of any event of knowing, it will not be easy to differentiate between them as being prime in this sense. Further the will, intellect, and emotion, of human consciousness cannot be supposed to be prime as being simple, but must necessarily be tremendously complex, as represented by the tremendous complexity of the three representative scientific factors within the "brain" (sensum) of man. The primeness of the psychic factors in the sense of being simple or 'elementary', must, on the hypothesis, be attributed only to these factors when integrated in the simplest events (persons), such as a photon and an electron, in the same way that the primeness of the scientific factors is only simple or 'elementary' within the simplest scientific objects (sensa), such as a "photon" and an "electron".

The relative certainty whereby the three prime scientific factors of sensa can be identified—although it should be remembered that they have only been distinguished from each other very recently in mankind's long history—compared with the uncertainty of identifying the three prime psychic factors of events, can be explained generally in the same way as was followed previously for the more obvious spatiality of sensa (scientific objects) over that of events (persons). The basis of the explanation is that sensa and their prime scientific factors provide a simplified representation of events and their prime psychic factors (see also p. 99). Also the psychic factors, when consciously and directly experienced, are highly localised processes involving motion within an event, whereas sensa and their prime scientific factors are extended in a sense-field and so may be more easily differentiated from one another.

The third condition is important because it enables us to pro-

ceed according to the plan which we have prescribed for ourselves in this investigation; namely to proceed from the relatively sure to what is less sure; and at this stage from science to psychology. What are the significant features of electricity, magnetism, and mesonism, which may be recognisable in the psychic factors and hence serve as criteria for ascertaining whether will, reason, and emotion, are indeed the prime psychic factors which are the objects of our search? First, we can say that magnetism is always simultaneously bipolar, never unipolar, and therefore is capable of pattern and, being bipolar, is also capable of repulsion and attraction. Secondly, electricity is also of two polarities, but these can be completely separated as independent entities, which is never true of magnetic polarity. Because of this, electricity of one polarity or the other has not the capacity of pattern intrinsically possessed by magnetism, but electricity, being bipolar, is also capable of attraction and repulsion. Thirdly, mesonism must be bipolar since it is capable of attraction and presumably also of repulsion. Also mesonism is closely connected with body and so with massiveness (as in the meson) and with form. It is very significant that all three factors are invariably in process of wave-like change. This has been known for many years for electricity and magnetism and has been found in recent years for mesonism. Mesonism can be regarded as more allied in nature to magnetism than to electricity, for the binding of nucleons in an atomic nucleus is effected through the exchange of mesons, which is comparable to the binding of atoms in a molecule through the exchange of electrons. Just as the latter bond can be related to the magnetic fields of the binding electrons so the former can be related to the mesonic fields of the binding mesons. In this manner mesonism is thought more to resemble magnetism than electricity.

Let us now examine whether it is possible to correlate the known properties of the proposed psychic factors with those of the scientific factors. *First,* reason is invariably simultaneously bipolar, having the bipolarity and direction of the cause-effect (p. 103), and subject-object relationships. Being simultaneously

bipolar, it is capable of pattern as shown in its judgements. It may thus be correlated with magnetism. Reason also may show its polarity by rejection or acceptance (repulsion or attraction) of what purports to be reason. *Secondly,* volition is also of two polarities, but these can be separated and distinguished, which is never true of the dual polarity of reason, where we have supposed 'cause' and immediate 'effect' to be contemporaneous. Of the two distinct polarities of volition, one is 'for' while the other is 'against' an event, although the polarities may 'neutralise' each other within one person, as is true also for the two scientific electrical polarities within a neutral chemical "atom". The repulsion or clash of the wills of two persons and also their attraction or agreement are well-known, which is in keeping with the properties of electrically charged "fundamental particles". *Finally,* like mesonism, emotion, so far as it can in some measure be separated from will, appears also to be bipolar since persons may love or hate another (although love and hate involve will as well as emotion). Further, like mesonism, emotion appears to be closely connected with body and so with mass, at least in depth; and also with tone and form. In addition, volition, emotion, and intellect, tend to oscillate in a wave-like manner from appetition to satiation, from emotional intensity to emotional indifference, from intellectual activity to intellectual sloth, and back again, respectively. For these reasons it is considered that the prime scientific factors may severally represent the psychic factors mentioned. These factors of volition, intellect, and emotion, will, therefore, be regarded as the three prime psychic factors.

Summary of the position

It is time now to call a short halt to our recent rapid progress and, whilst metaphorically recovering our breath, take the opportunity of looking back at the route along which we have so far travelled. The *first outstanding item of interest* is that the data (sensa) of sense-perception merely represent external events. In other words our knowledge of the latter is always indirect. Epistemologically, our sensum theory of sense-perception is

dualistic. The *second item of interest* is that external and internal events, sometimes termed respectively 'objects' and 'subjects' have characteristics in common. *The third,* carried further the train of thought aroused by the second. It is the hypothesis that external events like internal events are events of knowing. In this hypothesis Cartesian psychophysical dualism is abandoned and the universe is postulated to be monistic. The possibility of this hypothesis hinges upon the second item and also upon the meaning of the term 'consciousness'.

Support for the hypothesis is obtained by the following considerations in which I hope that I shall be forgiven some repetition. If we suppose (and there is scientific justification for this supposition), the human brain to be the centre of the highest levels of consciousness in man and if, going further, we suppose the human brain or at least the cerebral cortex *to be* 'conscious' man, then his brain having been uncovered so that he may 'perceive' himself, in a mirror, as the sensum "brain", he would be both 'object' and 'subject' of the perceptual event. External and internal event would thus be identical, namely the 'conscious' man or brain. The external event in this instance would therefore be an event of knowing. The "human brain" visual sensum has the same qualities, such as colour, shape, etc., and the same prime scientific factors, as any other visual sensum, for example the sensum "table". The sensum "table" represents the external event, table, as the sensum "brain" represents the external event, brain, and thus, like a human brain, a table would be an event of knowing. Finally, in this way, we may infer that all events would be events of knowing.

The assumption, in this argument, that the human brain *is* human conscious mind, will constitute a major obstacle which many will find difficulty in passing. The difficulty in the way of the acceptance of this assumption would appear to rest, in the main, on what has hitherto been the confusion of identifying the sensum "brain" with the event, brain. The traditional conception of mind as being very intimately associated with brain, but in a mysterious manner, mind being 'non-material' and without

extension, that is without body or form, or spatial properties—a conception derived from Descartes—would have to be discarded. But now that the nature of the intimate association of "brain" and brain (mind) may be considered to have been put on a more reasonable foundation, there seems to be less reason than before to persist in the traditional way of thought, that is, to adhere to the traditional Cartesian myth, the dark and profoundly unsatisfactory mystery of mind as ghost within the brain machine.

Difficulties associated with the meaning of the term 'consciousness' have been discussed. The consciousness of waking life would be seen to differ from that of sleep either by being the same proper wave-system, but of a different energy content or level, or by being a slightly different proper wave system. It is of interest to note that the 'conscious events of knowing' of our theory resemble the monads of Leibnitz, all being creatures of some degree of intelligence but, unlike the monads, events are not supposed to be 'windowless'.

The fourth item of interest, as we look back on our route, is that the three basic scientific factors of electricity, magnetism, and mesonism, must be regarded as factors of sensa, and not of external events. This follows because external events are never, on our sensum theory, presented directly to an event of knowing, say a human mind, but only represented there as perceptual sensa. Any inferences made by the scientists, from the qualities of perceptual sensa, concerning the nature of the prime factors of external events, hidden from their direct knowledge, cannot be justified. If they restrict themselves, as they must as scientists, and as some of them, for example Einstein and Planck, agree, to the qualities of perceptual sensa, then they can only infer from these qualities the existence of prime factors related to these qualities, and therefore related to perceptual sensa. The three prime scientific factors are thus the prime factors of sensa. This conclusion could be regarded as being in the direct line of succession, following, more immediately, from Hume's conception of causation as the habitual and orderly sequence of perceptual sensa, but eventually, from Berkeley's identification of the

qualities of 'matter' with those of sensa. Perceptual sensa, nevertheless, represent events, and so we come to *the final item of interest, the link between science and psychology*, that we set out to find. This is that, *as sensa represent events, so the three scientific factors of sensa represent the truly fundamental prime factors of events in the universe.* These we consider to be the prime psychological factors: volition, intellect, and emotion, represented in sensa ("matter" and gravitational field) by undifferentiated electricity, magnetism, and mesonism, respectively.

The position that we have attained, although it could be claimed to have been reached in a reasonable manner, may appear strange, especially as it concerns the relationships: (1) of mind and body, and (2) of science and psychology. First, mind would be both body and field, and being body would have shape and size and generally would have position and extension in the universe. It would also be divisible. This would be a most unusual view of mind. Secondly, the findings of the natural sciences would be seen to be simplified representations of events of knowing, psychical events. Strange as this position may appear to be we shall accept it for the reasons which we have given. We shall accept it also to find out whether, after a minimum development of its implications, it may be seen to be in general agreement with scientific evidence, resolve certain scientific problems (Chapters V, VI, and the Appendices) and also be capable of throwing light on wider aspects of human knowledge (Chapters VII and VIII).

The wave-change within the constancy of an isolated event

In the development of the hypothesis we shall deal first with the reconciliation of continual change, the flux of Heraclitus, with permanence. As has been revealed, any isolated event, which excludes perceptual events, is permanent in contrast with the relative transience of a sensum. In some as yet unexplained way an isolated event remains constant, although incessant wave-like changes in the prime psychic factors occur within it. For example the magnitude of the factor of emotion in human consciousness (event) may increase, but the increase is not maintained and is

invariably followed by a decrease. Similarly an increase in magnitude of the intellectual factor is always followed by a decrease and *vice versa*.

It is partially because the changes in the magnitudes of the factors are wave-like, waxing and waning alternately, that there is no fundamental tendency for an event, as an isolated whole, to change, over a finite period of time, which is long relative to any factorial wave-period. But this cannot be the complete explanation because, if all three factors were to wax and wane concurrently, the event itself as a whole would wax and wane once during a factorial wave-period. Further the factors of will and intellect being bipolar, wave-changes in these ranging from one polarity to the other through zero magnitude, the whole event (neglecting for the moment the factor of emotion) would under these circumstances, be annihilated and re-created in inverse form twice during each complete wave-change. This would be akin to the modern scientific electromagnetic wave-picture of the "photon". Admittedly an event, then, would be of similar factorial and overall magnitude at corresponding phases of successive periods of the wave-change. However, this kind of periodic phase similarity or 'constancy' is not the kind of constancy that an isolated event exhibits, for this is constant in some way throughout the whole of the finite period of time referred to, as has been described earlier in the chapter. The over-all constancy or perdurance of an event can only be due to constancy *either* in the magnitude of some psychic factor or factors during this time *or* in the summation, as a 'resultant', of the magnitudes of different factors, or possibly to a combination of these alternatives.

We will now examine these alternatives. In the first place it is known that an increase in the magnitude of the factor of emotion occurs simultaneously with a decrease in the magnitude of the factor of reason. This is recognised in the use of such statements as: "emotion clouds the intellect" or "reason"; and that the human intellect is or tends to be a "clear, cold, logic engine" where the term "cold" implies that intellect functions best with-

out the association of the "warmth" of emotion and therefore, of emotion. Thus the magnitudes of the factors of emotion and reason (intellect) will be supposed to be so reciprocally related in any isolated event that their 'resultant' is always a constant. It would follow that, to ensure constancy of the isolated event as a whole, the third psychic factor, the factor of volition must be of an overall constant magnitude. To discover whether this can be the required interpretation we must first of all find out how the three psychic factors are associated within an event, and whether the mode of association would allow of the 'reciprocal' fluctuations of reason and emotion, which are fundamental to the interpretation.

Ex hypothesi, there must be three types of processes of knowing or experiencing within any one event (person). These are: (1) the *three single processes* of pure volition (V), pure emotion (F), and pure reason (I). (2) *two duplex processes* which will be termed 'cognition'* and 'conation'*; cognition (VI), being composed of volition and intellect, and conation (VF) composed of volition and emotion; and (3) *the triple process* (FVI), or the event itself, which is composed of all three factors. The realisation of each single process alone may be approached, but can never be achieved because there is always association with the other factors. Theoretically, there could be a third duplex process involving the factors of intellect and emotion, but volition appears to be a necessary factor for any duplex process of knowing. The duplex processes of cognition and conation are distinguishable but are inseparably associated or integrated in all events. As Professor Broad has said (*The Mind and its Place in Nature*, p. 565), "We cannot desire, fear, hate, or love anything, without having an idea of the object towards which we take this attitude." But these two duplex processes are qualitatively different from

* There is a departure here from the usual nomenclature of psychology, but in the interests of simplicity it was thought preferable for continual use to employ the term 'cognition' rather than 'will-intellect process' and 'conation' rather than 'will-emotion process'. The single processes of intellect, will, and emotion, themselves constitute those processes normally termed the 'cognitive', 'conative', and 'affective' processes respectively.

each other, for when I think of my lunch the quality of my consciousness is different from that when I want my lunch. In both there is the factor of volition or there would be no will to think and therefore presumably no thought, in the first instance, and no will to want and therefore presumably no desire, in the second instance. The difference in the quality of consciousness in the two kinds of processes—'thinking' and 'wanting'—cannot be provided by the factor of volition, which, being the same factor, is the same qualitatively for both. It must be provided by the different "weighting", through the two duplex processes, of the factors of intellect and emotion respectively, all three factors being present in each state of the event.

From this account it would follow that the factors of emotion and intellect are each linked to the factor of volition, but never directly to each other. So the order of the association of the three prime psychic factors within any event would be: emotion—volition—intellect; and would be symbolised F.V.I.

This order of linking would enable us to have the required 'reciprocal' fluctuations of the factors of reason and emotion within the constancy of an event. For there could then also be wave-changes within the constancy of the factor of volition, these wave-changes being those within its constant magnitude as apportioned to the 'reciprocally' varying magnitudes of the factors of reason and emotion. The factor of volition would provide the very necessary central factor, linked in the trinity of factors, to provide for the wave-changes in the two flanking factors. Wave-change within an event could be considered to be initiated by any one of these three factors, none having priority over the others in this respect, and such initial wave-change would simultaneously be associated with corresponding wave-changes in the other factors. It appears then that the proposed explanation of the overall constancy of an event, associated with its incessant factorial wave-changes could be found in the constancies of: (i) the 'resultant' of the factors of emotion and reason and (ii) the resultant of the two components of volition. I shall assume this to be the true explanation.

In consequence, amongst the scientific factors, mesonism would more closely resemble magnetism than electricity, in so far as mesonism and magnetism would both be factors flanking the central factor of electricity. Here there would be agreement with (i) what has previously been recognised as a resemblance between them (p. 86) and with (ii) the constancy of magnitude of the electrical factor (*i.e.*, the electrical charge) of an "electron". This must be regarded as scientific evidence in support of the development of the hypothesis.

There cannot be considered to be any generation or destruction of one psychic factor by another, because the factors are prime and thus no factor can *cause* an effect in another. The synchronous wave-changes in the three factors of an event are due to the intrinsic wave-like nature of each factor. Similar representative synchronous wave-changes of the scientific electrical and magnetic factors of a visual sensum are observed in the scientific world of the sense-field. These are sinusoidal and from this scientific evidence it will be inferred, according to our usual method of procedure, that the wave-changes of the psychic factors are also sinusoidal (see Appendix 1).

The association of the psychic factors is not simple, however, as will be gathered later, in Chapter V, where an event is seen to have a slow component wave-change (L), induced by the nature of the factor of emotion, and also a rapid component wave-change (S), induced by the nature of the factor of intellect. One important difference in the natures of these two factors is shown by the fact that emotion tends to move us relatively slowly ($v_L < c$), whilst in the intellect rapid thought changes may occur ($v_S > c$). The symbol, c, represents the velocity of light *in vacuo*, and the symbol v, the velocity of change generally.

The explanation of the different qualities of the scientific and psychic factors

On the basis of the hypothesis we have now to explain how and why the three prime scientific factors of the sense-fields, within a conscious perceptual event, are different from, and yet do

represent, the three prime and constitutional factors of all events. From the scientific evidence of representative sensa, which consist of "body" and "fields" (electrical, magnetic, mesonic and gravitational) an event correspondingly consists of a compact body and of diffuse fields of volition, intellect, and emotion. There is no sharp boundary of demarcation between the body and fields of an event—this is inferred from scientific evidence—but there is a very sharp increase in the factorial intensities on proceeding from the fields, through what is normally regarded as the boundary between body and fields, to the body. The increase in this direction (or decrease on proceeding in the opposite direction) is very sharp. But there is very slight, if any, variation over what may be incalculable distances, in the magnitudes (not intensities) of the factors in the fields, as shown by the evidence of the representative scientific "fields". All three factors must be supposed to persist throughout any event (person) through body and fields alike, for there appears to be no reason at all why, say one factor, such as that of emotion, should vanish entirely from the fields. Indeed, scientific evidence shows that all three scientific factors do persist in the "fields" of sensa, and therefore, in the sense-field of a person.

We can now see our problem more clearly. It is this: How can we conceive the sensa and the sense-field, which must exist within the whole field of an event, to be qualitatively different from the body of this event, when we know that the three psychic factors must all persist throughout the field as well as the body? The answer, which we give to this question, rests on (1) the wave-phase difference, amounting to quarter of a wave-period, between a cognitive (VI) duplex process and the associated conative (VF) duplex process, (2) the momentary disappearance of the conative process when the cognitive process is at a maximum and of the latter when the former is at a maximum, and (3) above all, the intellectual, reasoning, and open-patterned judgement quality of the cognitive process.

The first of these bases to the solution of the problem posed for our sensum theory of sense-perception, has been dealt with

generally, excepting for the extent of the phase difference between the two duplex processes. This corresponds to quarter of a wave-period, where 'period' refers to the time of one complete wave of change for each process. The two 'periods' must be equal because the two duplex processes are supposed to have a common factor of volition. Each duplex process disappears twice during a wave-period. Each must also twice reach a maximum, but a maximum involving different polarities, during each period. In order to reconcile the constancy of the whole triplex event with the wave-change of the two duplex processes constituting it, one of them must be at a maximum when the other is at a minimum, that is to say, has momentarily vanished. Thus to ensure the constancy of any isolated event and as a consequence of there being two maxima and two minima for each duplex process during one period of wave-change, there must be a phase difference between them of a quarter of a wave-period. Herein is the explanation of the synchronous and mutual 'reciprocity' of the processes of cognition and conation, which removes the need for any other theory of pre-established harmony amongst the three factors of an event. *A scientific "event" is constituted correspondingly of synchronous quarter-period out-of-phase electromagnetic and electro-mesonic processes.* Incidentally the second basis to the solution has also now been dealt with. The third basis is to provide for the open-patterned intellectual judgement (about the external universe of events) which is present in the sensum of any perceptual event, and which can only be catered for by the simultaneously bipolar factor of reason and therefore in a cognitive process.

We are now able to present the solution to the problem of sense-perception as it arises from the hypothesis. Visual perception will be considered as the prototype of all sense-perception. A number of photons, each an event composed of the three prime psychic factors and moving in the universe, reach the body of another and larger, more complex, event—the external event (object). The psychic factors of both kinds of events are altered owing to their close mutual association even though this is

momentary, but we shall only concern ourselves with the alteration in the photons. The modified photons then travel again through the universe until they reach the body and we must suppose, the eyes of a human event (subject). A perceptual event ensues in which modifications of the psychic factors of constituent events, eyes, optic nerves, and especially brain, must be supposed to occur within the human event in that sequence. These modifications of the subject will represent to some extent those made in the original photons by the external object. The modifications of the subject in which we are specially interested, are those fully consciously experienced wave-changes of his brain (not his "brain"). His cognitive field processes being rhythmically and periodically segregated from his conative field processes, and being capable of almost infinite speed will ensure an almost instantaneous change, a visual sensum, in a rectilinear direction, focused at a locus in the subject's sense-field corresponding to the place of the external event (object) in the universal space. The focusing process, one of extraordinary accuracy and detail, must be attributed to the eye, the nervous system and especially the brain. The associated conative field processes are at a minimum when the cognitive field processes are at a maximum. Further they can never provide the necessary kind of open-patterned judgement always present in the sensum of the perceptual event, because they contain no factor of intellect. This factor is unique, since it is simultaneously bipolar in an open-patterned and distinguishable manner, and hence it is here considered that it alone can give the kind of judgement patterns required for the formation of sensa. Thus it is thought that the sense-field and sensa are composed of one only of the two duplex processes of an observer, namely his cognitive processes.

A possible objection to this part of the solution is that, if one were to "look" long enough in the direction of the external event (object) then some part of one's conative field processes might conceivably reach the place of the sensum and thereby possibly alter it, whereas no visual sensum suffers a sudden qualitative change of the kind that would then be supposed to happen. This

objection, if made, would be due to a misapprehension. The changes in the sense-field of a complex subject will be considered to be an integrated composite of rapid (S) wave-changes in the sense-fields of constituents of the human event (subject). Now the to-and-fro rapid wave-change (Appendix III) between each constituent's body and associated sense-field means that each integrated complex of focused cognitive field changes, producing a momentary sensum, will be exceedingly transitory and much more so than the sensum as experienced. The 'permanence' of the sensum, as experienced, will be due to the occurrence of such momentary integrated wave-changes, in relays. The sensum will thus be produced by the changes in the cognitive field processes alone, unassociated with conative field processes. The latter are out of phase with, and also at right angles to, the related cognitive field processes. Thus although the fields of one event consist of all three psychic factors, albeit of extremely low intensity, these will be associated in cognitive and conative pairs and the latter pair for reasons already given will never appear in the subject's sense-field. A sense-field will therefore be constituted entirely of one or both factors of the cognitive field processes. If only one factor were involved then it would be that of intellect, for reasons given above.

The sense-field and the sensa which it contains are thought to be constituted of extremely unsubstantial and therefore non-causative field processes, either duplex cognitive (VI) or single intellectual (I) processes. Since, according to the hypothesis, they represent events of knowing composed of all three factors, (V, I, and F) it follows, first of all, that they will necessarily be qualitatively different from events, but even so will be 'mental' in being either field cognitive or field intellectual processes. Secondly any sensum will be only a fraction of the external event (object) which is represented. The fraction would be different according as to whether the sense-field is composed either of intellectual field processes or of the duplex cognitive field processes. Thirdly the subject of the perceptual event being qualitatively the same as the external object, would only 'know' this

and the factor(s) within it as a similar fraction. Thus each psychic factor in the external event (object) represented by the sensum will be represented within, and known by, the subject as one of these two fractions of what it truly is.

The decision as to whether the intellectual field processes alone, or the cognitive field processes, can better be supposed to constitute the sense-field, may be arrived at from the following considerations. The factor of intellect alone can be considered sufficiently intrinsically extensive (Appendix III) to be capable of forming sensa, and in this connection, especially visual sensa. Also the kind of open-patterned judgement inherent in the factor of intellect *is* essential for the formation of sensa. Nevertheless, both the factors of the cognitive process must be considered to be active in the production, but not in the formation, of sensa. We shall therefore suppose that sensa are constituted of intellectual field processes only. *The nature of the scientific factors,* as known within the *sense field* (I) of an event, by its *body* (VIF) would be symbolised as shown. Mathematical manipulations are not possible with these 'fractions'—the psychic factors are obviously not multiplied together, in the mathematical sense, within an event.

$$E = V \times \frac{I.}{V.I.F.}$$

$$M = I \times \frac{I.}{V.I.F.}$$

$$O = F \times \frac{I.}{V.I.F.}$$

It would then be possible, on the hypothesis, to arrive at the conclusion that, for example, the scientific factor of electricity (E), representing the psychic factor of volition, is qualitatively quite different from it. This had to be established if the hypothesis were to gain the slightest credence, for it would be incredible to suppose that electricity and volition are one and the same thing.

Similarly magnetism (M) and mesonism (O) would be qualitatively distinct from intellect and emotion respectively, although they would be the scientific representatives in sensa of these psychic factors in events. The hypothesis would remove electricity, magnetism, and mesonism, (as well as gravitation), from the position of being really fundamental prime factors of the universe, as believed by some scientists. The nature of the scientific factors has been shown to be capable of description in terms of three prime psychic factors alone (see Appendix III for this kind of description of the gravitational factor). It would thus simplify and unify the interpretation of the universe, including the worlds of science and psychology.

Replies to possible criticisms of the present sensum theory

I may be taken to task because the present description of the world of science denotes as many such worlds as there are scientists, each world being private. How then could the 'reproducibility', 'publicity' and 'objectivity' of the results of scientists be explained? The reproducibility could be reasonably attributed to: (1) the close similarity of constitution of all human events (persons), including scientists, at least so far as their private sense-fields are involved, and (2) the representation of the same public universe and its constituent public external events (objects) within the sense-fields. The publicity of science would be merely privacy. But, because of the conditions of the privacy, there would appear to be publicity and objectivity. The objectivity would only be of the scientist's own perceptual sensa, but as the perceptual sensa represent external objects (events), there would be a simulation of true objectivity in the representative appearance of the sensa.

Another objection might be that the sense-field of any human event (man) is normally inviolate, and private to him, and yet, according to the present theory of sense-perception it is a field part of him extending to infinite distances all round him. Now there are many men and animals, etc., which must all be supposed to have somewhat similar fields and these must therefore overlap.

Why and how do the fields not interact as electrical or magnetic "fields" appear to interact? If they do interact then the sense-fields of different men can no longer be quite private, which would be contrary to our experience (if we exclude the reported abnormal experiences of extra-sensory perception, telepathy and what Professor Rhine calls 'psi phenomena'.) The answer is that the sense-fields of men and presumably of animals are considered to be so extremely unsubstantial that they are of negligible causation towards each other (Appendix III). This being so the sense-fields of the myriads of events (persons) in the universe may all extend throughout the universe and be part of this without normally having the slightest consciously perceptible effect on each other as experienced by events regarded as subjects. *Extra-sensory perception,* psi-phenomena generally, and such phenomena as animal and especially *bird migration* over the earth, would however, be possible owing to the interaction of the *whole* fields of events (not of their much 'thinner' sense-fields (Appendix III), under suitable conditions, in contrast with the body or near-body interaction of events, during sense-perception. Thus sensa, scientific objects, existing as non-causative objects within the space-times of the sense-fields which they populate, and which largely overlap each other, may also constitute parts but non-causative parts of the public space-time of the universe. Sensa, both scientific objects or perceptual sensa, and also non-perceptual sensa such as dream-images, may inhabit the public universe but only as exceedingly 'thin', non-causative objects.

The Nature of 'ideas'

In connection with any theory of sense-perception and 'knowing' generally, 'ideas' are usually an important feature. I have refrained from using the term 'idea' up to this point excepting in discussing the history of representative sense-perception, but now briefly it must be touched on. From the hypothesis there are three types of processes of knowing: single, duplex, and triple. It may reasonably be supposed that only those processes which include the factor of intellect can possibly pro-

vide 'ideas'. Thus *the single process of intellect, the duplex process of cognition, and an event itself, would be the only processes which would provide 'ideas'*. Cognitive field processes may thus be supposed to yield (1) *sensa or percepts* which constitute one kind of the representative 'ideas', the 'ideas got by sensation', of Locke. They would consist of the attenuated field factor of intellect. The other kind of Lockeian representative 'ideas', the 'ideas of reflection', would be (2) *concepts* or mental contents also having the qualities of the factor of intellect but more intensely. Finally (3) *events* would be hypostatised 'ideas' or persons composed mainly of the three intense body factors. According to this hypothesis these three would be the only kinds of 'ideas' which are possible.

Inferences of the Hypothesis for Psychology

The elementary bases of psychology are now regarded as having been clarified by way of a hypothesis which relates psychology to what is relatively sure in human knowledge, that is to science. No more than this can be said. Some of the difficulties of the interwoven complexities and intricacies of psychology are apparent to the non-specialist, but they and many others, hidden from him, require unravelling by the specialist. Thus the present proposed simplification of the bases of psychology would make no kind of pretence to have made simple and clear the many perplexities within the province of psychology. Nevertheless a more orderly interpretation of these would now be possible if the hypothesis were to be accepted. Further, the simpler and more certain evidence provided by scientific investigation would be available for this more orderly interpretation of the processes of mind and spirit. An enormous body of evidence of this kind is already available and if the main hypothesis were true, this scientific evidence, including that of the 'electronic brain' and of cybernetics generally (see *e.g.* J. O. Wisdom, *The British Journal for the Philosophy of Science*, 1951, p. 1), would constitute in its modified form, where the psychological factors are substituted for the corresponding scientific factors, a con-

firmed, consolidated, and vast groundwork for organised psychology. This procedure would be a rational extension of the modern observational and experimental method as contrasted with the introspective method in psychology.

The Concept of Causation: Cause and Effect

The concept of causation involves two other ideas: (*a*) that of orderly change, shown by perceptual sensa and also by my own inner experience, and (*b*) that of power of producing orderly change, revealed to me directly in my own inner experience and thus, by my arguments, existing in all events of knowing. Causation inhering in the substance of events would be merely represented by the "causation" of perceptual sensa. These two ideas concerning causation have already been discussed sufficiently.

What I want to consider now is the temporal relationship of 'cause' and 'effect'. Is cause antecedent to effect or are they strictly contemporaneous? Orderly change or movement can be supposed to proceed in the simplest event, for example, in a photon *or* an electron (see Chapter v), when it is isolated from all other events. In other words, orderly change is inherent even in the simplest isolated event. It is therefore not necessary to suppose that change or movement is produced fundamentally by the association of events. What then becomes of cause and effect? Clearly it is impossible to distinguish between them logically. To either or both could be attributed the identical process of change of an isolated event, and if to both, they would be strictly contemporaneous. In this respect there would be a close resemblance to the simultaneous bipolarity of magnetism and intellect. Simultaneous cause and effect, of the type mentioned, could be thought possible through the synchronous influence of one psychic factor on another within the isolated event, as already described. However, it is considered preferable to restrict the use of the terms cause and effect to the mutual influence pertaining to what may be called 'fundamentals' of the same kind, of will on will or of event on event; and *not* to that between 'fundamentals'

of different kinds, of will on emotion or intellect, or *vice versa.*

When two events, A and B, interact, which is to say, become associated, even momentarily, then A will appear to cause change or effect in B, if B can still be considered to remain B, during the association. Reciprocally B will appear to cause change or effect in A, with a similar proviso. These two reciprocal pairs of causes and effects must be strictly contemporaneous, at one moment (when they are simultaneous) and in the time sequence, because during the period of the association or change, A and B form one event and therefore similar conditions prevail as prevailed in the isolated event considered in the last paragraph. The same inferences may thus be drawn, except that now, strictly contemporaneous cause and effect, of event on event, can rightly be supposed to occur.

Nevertheless, the impossibility of differentiating logically between 'cause' and 'effect', because of their being strictly contemporaneous and reciprocal, does not affect the existence of the power of orderly change, which we call *causation*, inhering in the substance of events. We shall suppose causation to be shown when one event A becomes associated with another B and induces in it a deviation of behaviour as represented in the perceptual sensa of my sense-field. In common parlance A would be called the ' cause' of the deviation of the behaviour of B from the normal, this deviation being called the 'effect'. As we have argued, however, this distinction in time and quality of 'cause' and 'effect' would be merely one of convenience.

CHAPTER V

MASS-SPACE-TIME, UNIVERSAL LAW AND ORDER

Mass-Space-Time: introductory

Some confirmatory evidence for the hypothesis will now be obtained by showing how it can be applied to the interpretation of scientific phenomena and the solution of scientific problems. It will enable us to interpret the wave-particle behaviour of scientific "fundamental particles" (see also Appendix I). The interpretation is based on the wave-like qualities of the three prime psychic factors as described in Chapter IV. That such an interpretation should be possible on what appears to be a remote basis, seems, at first sight, fantastic. Yet, that it *is* possible is evidence in favour of the hypothesis. Scientific evidence of the wave-particle nature of "particles" is well established, but the current scientific explanation involving 'substantial' electromagnetic "particles" on the one hand, and mathematical non-substantial 'waves of probability' on the other, whilst quite convincing in its interpretation of the probable behaviour of a particle forming one of a large number, a group, of similar particles, fails to reveal why, from its qualities, any one of the particles behaves as it does. Moreover Professor H. T. Flint (*A Century of Science*, 1951, p. 42), for example, has indicated the inadequacy of any theory according to which 'matter' is regarded as purely electromagnetic. As he says, there must be a non-electromagnetic contribution to the existence of a "particle". It is supplied by electromesonic processes, on the present hypothesis. This will be shown to be in agreement with an electronic theory of 'matter', with the quantum theory, and with Heisenberg's Principle of Indeterminacy. The hard cores of the problems posed by the scientific evidence of Entropy, the Red Shift

Phenomenon, and Evolution, will also be shown to be capable of being resolved, by applying the hypothesis to them.

Although any event is supposedly composed of three psychic factors, it is also supposed on the hypothesis to be a constituent of a large substantial or mass-space-time of either the nebular or photon kind. There will then be no inconsistency or absurdity to regard emotions, 'ideas', passions, desires, hopes, and fears, as having values of space and time within the bodies and fields of events which they go to compose. However, until there is considerable familiarity with this implication of the hypothesis, the air of unreality, which for the present at least attends its consistent application, as in the discussion of the wave-changes of events, may be removed by thinking in terms of sensa in place of events so that the names of the scientific factors are used instead of those of the related psychic factors.

The nature of space-time will be our main concern. From the hypothesis there are three main kinds of space-times corresponding to the three kinds of 'ideas' (p. 102). They are: (1) the many space-times of events in the universe, all being composed of the three prime psychic factors, (2) the many space-times of sensa, the space-times of science, composed of the extremely attenuated factor of the intellectual field processes of events (persons), and (3) the abstract space-times of the symbolised concepts of mathematicians, derived from the play of the factor of intellect alone. Although this factor cannot function in isolation from the other two psychic factors, yet it has its own specific quality and content. Thus conceptual or mathematical space-times are possible. They will only receive this brief mention here.

Each of the space-times, of the universe, and of science, is substantial or 'massive', the former being composed of events and the latter of sensa. Events are not placed or contained in the universe, as air is commonly supposed to fill a containing vessel, but they actually are constituents or parts of the universe. Events may be simple or complex. They may be more or less isolated from each other, which is to say that they may be less

or more associated with each other. Photons, cosmons and 'bare' electrons (Appendix I) or positrons are simple events; all others are complex. Of all ordinary events photons and nebulæ may have the greatest degree of isolation; but no event is completely isolated, because all events are associated in the universe.

The prime factors of volition and intellect are known by the scientist as the two factors of electricity and magnetism. We here also postulate the existence of a third scientific factor, that of mesonism. The factors of electricity and magnetism, when closely associated as in an isolated "photon" (pictured—wrongly—as purely electromagnetic), are invariably in planes at right-angles to each other, as would be expected of representatives of truly prime factors. The psychic factors represented, namely those of volition and intellect, when closely associated, as in an isolated photon, will be supposed therefore to be in substantial planes which are perpendicular to each other. For according to our hypothesis, because the scientific "fundamental particles", the "photon" and the "electron" are known to be spatially 'polarised', the fundamental particles, the photon and the electron, will also be spatially polarised.'

The "human brain" sensum reveals to the scientist an enormously complex collocation of associated "fundamental particles", and the factorial planes of these must be supposed to be oriented in an indefinitely large number of directions within the space of science. Thus it is that the electrical factor does not occupy merely one direction, but occupies every direction in scientific space and similarly so does the magnetic factor. Yet because of the 'primeness' of both factors they can each simultaneously fully occupy this space without either affecting the quality of the other. This is the interpretation of the three-dimensional character, of both electrical and magnetic fields in the space of science, and also of the three-dimensional character of the fields of any psychic factor in the universe. The inverse square law, concerning factorial intensity in the field of an event, can be interpreted by supposing the same number of factorial planes of one factor of an event to pass through spherical

surfaces, of area $4\pi R^2$, at different values of the distance R from its body.

The polarisation and different orientations of the intellectual processes of the constituent electrons, etc., of the human brain must be supposed, on our hypothesis, to be the foundation of all human understanding of number and of mathematics. The polarisation and different directions of these processes must be considered necessary for the focusing and differentiation of sensa and hence for the possibility of *the concept of numbers*—the different classes of the groupings of events irrespective of the shapes of the groups—and also for the 'perception' of different shapes or forms required for at least *the beginnings of geometry*. As we have observed previously, man can only be expected to apprehend those qualities in the universe or external world, which he already possesses in himself, at least in so far as experience of the universe enables him to actualise and develop them. Number and shape in the universe must have their counterparts in man, or he would not be capable of knowing them in the universe in any degree.

It is hoped that the doubts, to which the reader might otherwise have been susceptible, concerning the existence of an incalculably extensive sense-field associated with his brain, will by now have been dispelled. According to the sensum theory, without a closely representative sense-field, he could not possibly know, to such a high degree of spatio-temporal accuracy, any part of a more extensive external universe. His sense-field is supposed to be quite impalpable and imponderable, being of negligible substance and causality, so that far from it being an irksome burden he is always quite unaware of it in this way. He is however acutely aware of it through his sensa, which may be taken to be more or less accurate spatio-temporal representatives of events in the universe (see p. 233).

The wave-particle nature of fundamental particles

We have seen that any private space-time of science is a plenum, but extremely attenuated even where there are sensa.

The universe is always a much more intense plenum, even in its field portions, and it is considerably more intense where the bodies of events are located. The meaning of the term 'prime' as used for the perpendicular association of the psychic factors, volition and intellect, has been established through reference to the representative scientific factors and it would therefore appear to be true of the prime factors of volition and emotion within the duplex process of conation, that they also, at any moment, are in substantial planes at right angles to each other. It is thus possible to represent a scientific (purely electromagnetic) "fundamental particle" within a private 'scientific' space-time and a correspondingly simple event or particle within the universe, the former by two perpendicular planes and the latter by three planes all of which are mutually perpendicular. The space-times of both are represented as being three-dimensional. (Figure 1). The three perpendicular substantial factorial planes of a single event are here regarded as the substantial bases of the three perpendicular geometrical Cartesian co-ordinates of three-dimensional Euclidean or straight space.

The mass-space-times of (a) an "event", and (b) an event

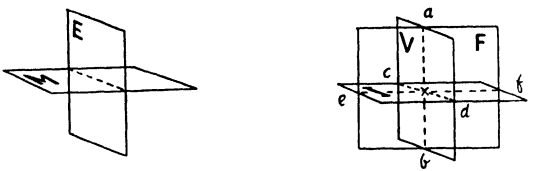


Figure 1

(*a*)

A simple "event" or "fundamental particle" within the space-time of science.
E, M, = "substantial" planes of vibration of the electrical and magnetic factors respectively, within a polarised electromagnetic "fundamental particle".

(*b*)

A simple event within the universe.
F, V, I. = substantial planes of vibration of the factors of emotion, volition, and intellect, respectively, within the 'short' wave-change(S) of a polarised fundamental particle. The factors of volition and emotion occupy planes F and V respectively, within the invariably associated 'long' wave-change (L) of the particle.

An event, since it has three factors, could be four-dimensional like the Minkowski world, but it is not necessary to postulate a fourth dimension. This is because the three-dimensional picture showing a polarised fundamental particle, immediately provides a clue to interpret the known wave-particle nature of a scientific "fundamental particle". It would therefore satisfy the requirements of the quantum theory. It will also satisfy those of gravitational field-theory (involving 'geometric' curvature of space-time, see p. 144) and of modern cosmological theory, although these require a four-dimensional world (see p. 115).

The basis of the interpretation of the wave-particle nature of the fundamental particle can be seen almost at a glance from the diagram (Figure 1*b*) but that of a "fundamental particle" could never be similarly explained because three 'planes' of vibration are required to define the centre of any kind of polarised vibrating 'particle'. Two planes of vibration, which are all that science has provided up to the present, for a polarised electromagnetic "particle", can never give a centre of vibration, but only a line or axis of vibration of indefinite length, along the whole of which the wave-changes of the "particle", in the two planes, may be supposed to extend at any moment. The picture, now given, of a polarised particle vibrating simultaneously in three mutually perpendicular planes and centred, at the moment chosen to picture it, at the point x, the point common to all three planes, would give the first notion to explain the wave-particle nature of any particle. Although particle-like it would also be wave-like, but could not be dissipated like a Schroedinger wave-packet because it would always be centred at the point common to the three planes. The planes of the factors of a simple isolated particle, whilst they are constant in direction, are not supposed to be stationary, but to move as their common point x moves.

The explanation of the wave-particle behaviour of a scientific "fundamental particle" would follow naturally, because this "particle" is representative of the fundamental particle. The

picture provided by scientists of the polarised electromagnetic "particle" cannot be true, not only for the reason already given, but also because this implies its periodic annihilation and re-creation. The restriction of assuming two factors only (the electrical and the magnetic), adopted by them for their interpretation of the wave-particle behaviour of a "particle", have prevented them from arriving at any clear understanding of its constitution. By inserting a third plane, that of mesonism, into Figure 1(*a*), a more adequate explanation (see Figure 2) can be reached of the wave-particle behaviour and nature of a scientific "particle", as already explained for a particle.

Amended picture of the mass-space-time of an "event"

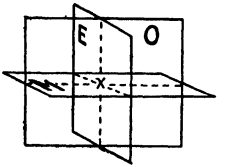


Figure 2

E, M, O, represent the "substantial" planes of vibration of the electrical, magnetic, and mesonic factors respectively, of a polarised scientific "fundamental particle" centred at X.

It must be explained that, contrary to any wrong impression which might be conveyed by the diagram of the simple event in the universe (Figure 1 (*b*)), the association of the factors of emotion and intellect would be indirect and not direct, although this is not obvious at first sight. It follows, however, from the supposition that the volitional component of the conative process is perpendicular to, and a quarter-period out-of-phase with, that of the cognitive process. This would explain why, although the planes of vibration of the factors of emotion and intellect appear to have a common axis e f (or c d) and thus appear to be directly associated, which would be in contradiction with the previous developments of the main hypothesis, the two factors are actually

never directly associated, but only indirectly through the factor of volition.

Mass-Space-Time

The substance of each of the three psychic factors of any simple event must be capable of quantitative representation in its plane of vibration and, since vibration in the world of science involves both 'space' and 'time', it will be supposed that in each factor these are two linear dimensions whereby each planar psychic factor may be quantitatively represented. Unlike the usual mathematical and scientific conception of space and time as being without substance or 'mass', we must regard them both as being substantial, because each psychic factor is substantial. In scientific terms all events are 'mass-space-time' events. We shall further suppose that the space and time of a factor (or component of a factor) are incapable of mutual inter-conversion, so that they are always inseparably associated at right-angles to each other, forming the required substantial space-time plane which is the psychic factor. The mass of a factor (and, as will be seen later, of the event as a whole) consists of *inertial mass*, the magnitude of which may be regarded as varying reciprocally with the space, and, of *rest mass*, varying reciprocally with the time, of the factor. The reciprocal variation follows from a consideration of the law of conservation of momentum:—the product of mass and extension (velocity), mv, of an isolated event is constant. Mass of either kind is therefore considered to be reciprocally related to its appropriate mode of extension, space or time. The ratio of space to time, within the factor of volition, which has constant total mass, and also within an isolated event, possessing constant total mass because it is isolated, will then have a maximum value when the ratio of rest to inertial mass has a maximum value (see table, p. 141). Since the space and time dimensions of cognitive volition become the time and space dimensions of conative volition the ratio of space to time within this factor can also have a maximum value, when the ratio of inertial to rest mass has a maximum value. Where α is the phase angle of the spin-

change (S) of a particle and the ratio of the masses of cognitive and conative volition is cot α, then the following are the values of the ratio of time (t) to space (l); (see Appendix III):—

$$t/l \text{ (cognitive volition)} = \cot \alpha.$$
$$t/l \text{ (associated intellect)} = c.\cot \alpha.$$
$$t/l \text{ (conative volition)} = \tan \alpha.$$
$$t/l \text{ (associated emotion)} = \tan \alpha/c. = 1/(c.\cot \alpha).$$

Similar ratios may be derived for the orbital change (phase angle β).

From Figure 1 (*b*) it will be possible to gather that the three temporal dimensions, like the three spatial dimensions, of the three factors of a simple event, will be mutually at right-angles, and lie in the three factorial planes of the event. Temporal and spatial dimensions will therefore be equivalent, at least in the sense that the spatial dimension of one factor may lie in the same linear direction, within a simple event, as the temporal dimension of another factor. Thus on the present picture of a three-dimensional space-time of a simple event, space and time, although in a way different, would also be considered to be qualitatively similar, in that both may occupy the same dimensional direction. This would be particularly obvious with the two components of the factor of volition within a simple event, where the two components are supposedly at right-angles, for this would involve the mutual interchangeability, that is the entire equivalence, of their spatial and temporal dimensions. Since the space and time dimensions of cognitive volition become the time and space dimensions of conative volition the ratio of space to time within this factor can also have a maximum value, when the ratio of inertial to rest mass has a maximum value.

Since space and time are supposed, from our picture of an event, both to occupy all the dimensional directions of the postulated three-dimensional space-time of any event, simple or complex, and thus to be qualitatively similar, it is now necessary to consider how they are different. That there is a difference between

them will, no doubt, be generally admitted. It must be supposed to lie in the unidirectional quality which the time of an event possesses, but which the space of an event does not possess. Both must be supposed to persist equally within the permanence of an event, for it would be impossible to suppose time to exist without space, or space without time. They must be considered to be knit together inseparably in space-time, as for example Alexander (*Space, Time, and Deity*) has shown.

The effect of the polarity of the factors of an event on their spatial and temporal dimensions will now be clarified. Each of the factors of volition and intellect periodically reverses its polarity. Both the temporal and spatial dimensions of each must be capable of assuming opposite directions, synchronously but not concurrently—they will be out of phase by quarter of a wave-period—when the polarity of either factor becomes inverted. There is no good reason why only one of the two dimensions should be so affected. This dimensional change within a factor, when the polarity of the factor is inverted is indicated in Figure 3 (*a*). The factor of emotion requires further examination. It has previously been diagnosed (p. 94) as producing motion of relatively low velocity ($v_L < c$). In this way it may be regarded as being unipolar during relatively long periods, but as suffering rapid wave-like change within this one polarity, due to its association with a rapidly fluctuating factor of volition, the change being induced by the factor of intellect of a high-frequency or short-period wave-change (S). It will be supposed that this is true. But even the one polarity of the factor of emotion must, of itself, be supposed to experience a relatively very low-frequency or long-period wave-change (L), similar in kind to that of the other two factors, but which can only be compared to a half wave-change (see p. 118) of these factors as they are pictured in Figure 3 (*a*).

It is this relatively enormously long-period half wave-change of one polarity, necessarily occurring in one direction only, which provides for the general direction of motion of an event. This half wave-change of the factor of emotion and of the

invariably associated factors of volition and intellect provide for the *life-time of the event*. Thus, in addition to a 'short' wave-change (S) (Figure 4) which is of short wave-period (but not necessarily of short wave-length) and produced by the intrinsically short wave-period of the bipolar factor of intellect, a simple event or particle is supposed also to be composed of a unidirectional 'long' half wave-change (L) (Figure 4) of relatively long wave-period (but not necessarily of long wave- length) produced by the intrinsically long wave-period of the factor of emotion, and in which the plane of the factor of volition is perpendicular to that of the 'short' wave component. Thus although the time of an event is unidirectional it is also three dimensional or better, three factorial.

This explanation of the unidirectional nature of the three-dimensional time of an event does not go so far as to make the three-dimensional space of the event unidirectional. The reason is that although the space, of the body and fields of an event, is supposed to be produced, like the time of the event, by all three factors in the combined short-(S) and long-(L) wave-changes of the event (Appendix III) yet the space, unlike the time, is mainly produced by the short wave-change (S) and is therefore not unidirectional. The space of the body and fields of an event is therefore three-dimensional, where the three dimensions are mutually at right-angles and are of the Cartesian variety. The wave-path or space-time-path of an event, may be regarded as uni-dimensional, and since it is here regarded as lying or extending outside the three dimensional space-time of the body of the event, any event, but not the universe, may be looked on as four-dimensional. This would be true, therefore, for any nebular event. That is to say, an event could only fully be characterised for mathematical analysis by four numbers or dimensions (in this particular sense of the word 'dimension'), three being co-ordinates to denote its position in the three-dimensional space-time of the nebula containing it, and one to denote its position in the wave- or space-time path of the nebula. The wave-path of an event may for convenience (but wrongly) be called its

time-path, since it is mainly determined by the time wave-change (L). The nebula could, in this way, be held to resemble a four-dimensional space-time continuum, in keeping with the requirements of modern gravitational and cosmological theory. However, all events would be included in one substantial universe, which is quite unique, being without 'space' and 'time' where these terms denote directional intervals, because the universe is here supposed to be overall symmetrical (p. 131), and hence to be quite steadfast with no space-time-path.

The 'time' of any nebula and thus of all events would then be seen to be 'spatial'. A complex event, for example a man, would be potentially multi-directional in contrast with an isolated photon. Therefore a complex event would be capable, within limits, of a choice of movement in any direction within a four-dimensional nebula. But spontaneous movements, as in a man's 'high-jump' or in a journey around the earth, would be minor deviations from the mean time-path, as discussed above and as determined mainly by that of the nebula of which the event is a constituent.

To some, the 'spatial' representation of time may seem impossible. For example a man may move to and fro on the earth about his home as centre and all his movements may thus appear to cancel each other. From this it would be inferred, on the present theory, that time has also moved to and fro for him and not in the one forward direction known to be characteristic of time. However, man in his normal consciousness, is not aware of his rapid motion relative to the sun, yet this motion does occur. The sceptic would reply that even this motion is cyclic (although it should here be mentioned that the motion is not truly cyclic but is spiral) and so a man's movements once again would appear to cancel each other, from which the same inference could be drawn as before. But, a galaxy of stars, a nebula, is not set in fixed and stationary position. Our own galaxy is moving relative to other nebulæ, and this movement is not rapidly oscillatory like that of the earth about the sun. Therefore without normally being conscious of it, man may be moving in one general direction. This unidirectional 'spatial'

movement may be supposed to be man's unidirectional 'temporal' path. It is more truly his space-time path. It is a very small part of that of the nebula of which he is a part, the nebula itself being a constituent event of the universe.

Just as each psychic factor has two perpendicular components, space and time, so has each event its short and long wave-changes, which can be termed its 'space' and 'time' respectively. Also each of these has two components; its cognitive process, which can be regarded as its 'space', and its conative process, which can similarly be regarded as its 'time'. Thus the space (S wave-change) of an event is to some extent temporal, and the time (L wave-change), to some extent spatial, (see Appendix III).

When an event is not isolated, the ratio of space to time in the short (S) as well as in the long (L) wave-change must be supposed to alter. The spin-path (Figure 3a) would then no longer be circular, but might be elliptical or might even be rectilinear. The same would be equally true of the orbit (Figure 4).

To summarise: the mass-space-time of an event involves not only the space-time of each factor but the space-times of the 'space' and also of the 'time' component of the event.

The wave-path of a fundamental particle

The wave-path of a scientific "fundamental particle" has for long been one of its puzzling and mysterious characteristics. It can, however, be explained on the present interpretation of the substantial space-time of an event, where the event considered is an isolated particle or simple event such as a photon. From the hypothesis leading to our present notion of the space-time of an event, the space-time path of the centre of the photon would be a helix curve whose axis would be determined by the 'time' wave-change L (Figure 4), and whose amplitude would be determined by the 'space' wave-change (S). The substantial body and field of the photon (or any event) would be manifested around the centre of the photon throughout its path, in the quarter-period out-of-phase but synchronous wave-changes, of the two duplex processes of cognition and conation of the time

and space wave-changes, as is described in Appendix III. The axis of its motion is represented (Figure 3) as being 'rectilinear'. The meaning of this term is clarified on page 121.

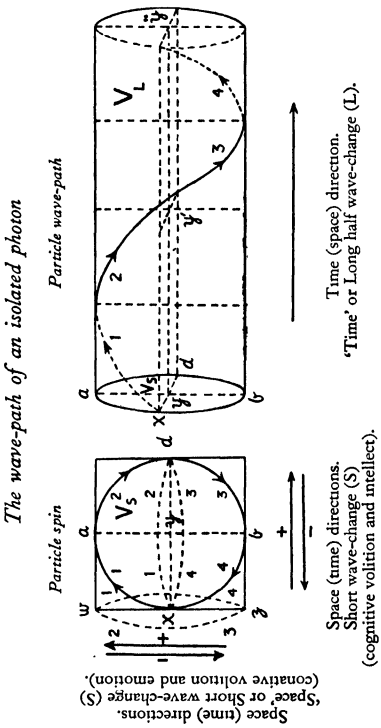


Figure 3

The 'space' wave-change of the photon will be considered first. In Figure 3, *x w x z x* represents the *rectilinear path*, which would be traced by its centre in each 'space' wave-period

(the sinusoidal wave-change of its velocity (extension) being represented by the broken-line curve) if the conative component were the only component of the volitional factor and if this factor alone constituted the space wave-change of the photon. This would also represent the path if the factor of emotion (in the 'space' wave-change) alone constituted the space wave-change of the photon. In both instances the photon centre would describe a simple harmonic motion about the centre of this path. Similarly, *x y d y x* represents the *rectilinear path*, of the centre of the particle, if the cognitive component were the only component of the volitional factor, and this factor alone constituted the space wave-change of the particle. This would also represent the path if the factor of intellect alone constituted the space wave-change of the particle. In both these instances also, the photon centre would describe a simple harmonic motion about the centre of this path.

Having revealed that, if the space wave-change of the particle were composed of (*a*) only the factor of intellect *or* that of emotion; or of (*b*) only one component of the factor of volition, its path would be rectilinear, we shall now consider the path of the centre of space wave-change of the particle supposed to be constituted of all three factors. The cognitive and conative components of the factor of volition in the space wave-change are supposed to be out of phase by quarter of a space wave-period and their temporal dimensions are at right-angles to each other as are those of the factors of intellect and emotion. As a consequence *the path of the centre of the particle will be a circle, x a d b*, within the plane of the factor of volition, V_8, (Figure 3). In other words, as is well known, the composition of two mutually perpendicular simple harmonic motions (of the same period and amplitude) which are a quarter-period out of phase, gives a circle as the resultant path. Starting with the particle at *x*, the velocity of change of the cognitive component (and the factor of intellect) being zero, and that of the conative component (and the factor of emotion) being at a maximum—as shown by the broken line curves—the particle will move in direction *x w*, at the beginning

of the first quarter (marked 1 in the diagram) of the wave-period. But during the first quarter-period it will gradually move along the curve, *x a*, until at the end it will be moving along the direction *w a*, for then the velocity of change of the cognitive component (and the factor of intellect) is at a maximum whilst that of the conative component (and the factor of emotion) is zero. The rest of the explanation for the three subsequent quarter-periods (marked 2, 3, 4 in the diagram) is similar. The curve will be a circle (of radius *r*) because the whole mass of an isolated event is *ex hypothesi* constant, and it can be shown (Appendix 1) that the mass of the space wave-change is also constant.

Finally, we have to consider the path of an isolated particle constituted of both time- and space-wave components. Because the 'time' wave-change is unidirectional, the mean path of the particle will be along the axis, *y y' y''*, which is perpendicular to the plane of volition, V_s, of the 'space' wave-change. Thus the circular path of the centre of the hypothetical particle constituted of only a space wave-change, in the plane V_s, becomes for the whole particle, a *helix curve wave-path* (Figure 3 (*b*)). Both the space-(S) and time-(L) wave-changes of the whole particle (Figure 4) are involved in the component masses which determine the path. It is in this way that the hypothesis enables one further to see how an isolated particle or event, possessing an undulatory nature within permanence, can have *magnitude*, which is capable of being described in terms of the scientific dimensions of mass, length, and time (Appendix 1), the particle moving along a definite *wave-path*. That is, it is possible to see how a particle can have a wave-particle nature, and yet not be dissipated through its wave-changes.

The wave-path of a scientific "particle"

The explanation of the wave-particle behaviour of a scientific "particle" follows naturally from that just provided for a particle, by substituting, at all stages, the name of the appropriate representative scientific factor for the psychic factor represented. In a scientific "particle" however only the two vibrating electrical

and magnetic factors have usually been inferred as constituting it, and it has therefore been regarded as an electromagnetic "particle". The inclusion of the mesonic factor, in the electro-mesonic duplex process of an "event" would, on the present view, enable the wave-path of the scientific "particle" to be better understood. The hypothesis would agree with *the electronic theory of "matter"* in attributing a constant magnitude to the electrical factor alone, of a "particle". (Appendix II).

The amplitude, r, of the helix curve wave-path of length s, determined by the integrated space and time wave-changes of a photon, is revealed as being directly proportional to the wave-length, λ, this being measured along the mean axis of motion. For, where θ is the constant angle, between the tangent to the helix-curve wave-path (of the photon centre) at any point on this curve, and the mean axis of motion (of the photon centre), we have the following relationships:—

$$s = \lambda/\cos\theta \qquad (1)$$

$$\lambda = 2\pi r/\tan\theta \qquad (2)$$

$$\therefore\ s = 2\pi r/\sin\theta \qquad (3)$$

This direct proportionality of amplitude with wave-length (equation 2), would coincide with the scientific knowledge that the wave-motion of photons is more easily demonstrated for those of bigger wave-lengths; photons of smaller wave-lengths being more particle-like.

There is no distinction which can be made between the ratio of the orbital to the spin path, during one short wave-period of a particle, namely $\lambda/2\pi r = \cot\theta$, and the ratio of the speeds of change determining that ratio. Thus the second ratio, namely that of the speeds of the orbital and spin changes forming the body and field of the particle, is represented by $v_L/v_S = \cot\theta$.

The meaning of the term 'rectilinear'

A particle and indeed any event must be supposed always to consist of two component wave-changes, one of relatively short wave-period, integrated with the other, a half wave-change of relatively very long wave-period, so that the path of the particle

is, or is allied to, a helix curve (see Figure 4). As with the high frequency wave-change (S) the one long half-wave change (L) must be supposed to be composed of two 'reciprocally' related duplex processes of cognition and conation within which the factor of volition alone is of constant magnitude.

Because the mass components of the photon are not only constant in the space wave-change, but also in the time wave-change (see Appendix I), which will tend to alter polarity after a period that is relatively enormous compared with the space wave-period, the centre of a hypothetical photon composed entirely of the time wave-change would *also* trace out a circle L (Figure 4). The radius of this will be relatively enormous owing to a lack of substance in this time wave-change component of the photon. The wave-path of a photon would then be seen to be described over a surface which would be that of a torus represented by two circles S and L (Figure 4) whose planes are at right angles.

As a consequence of our hypothesis it must be supposed that a photon under suitable conditions is capable of conversion into an electron, and *vice versa*. Without going into many details at this point, the main conditions would be that the photon must have a certain minimum energy, ϵ, that is frequency, ν, (Appendix II), and also must be in space-time of suitable phase or 'curvature'. The inertial mass of the photon or frequency of the space wave-change thus being high enough to permit of the following possibility, then at a certain interim value of what we shall here designate the 'phase angle' ϕ, and during the rapid photon to electron change, the mutually perpendicular circles S and L would come to possess equal diameters. They would then be mathematically interchangeable and it would be impossible to differentiate between them. Beyond this stage the torus surface would disappear and finally a spherical surface would be formed, the centre of which would be the orbital circle L, now diminished to a point. The spin-path of the 'bare' electron would then, wrongly, appear to be its 'orbit'. The limiting value of ϕ would be 90° and this would be the value for the 'bare' electron.

For all events, and this includes photons and nebulæ, the orbit

would however, only be a semi-circle, because the change of polarity of an event (Appendix IV) at the end of one half of the long or orbital wave-change, coinciding with a change of polarity of the factor of emotion, would signify the dissipation of the event.

This requires an explanation, which runs as follows:—From our knowledge that mesonism is of much shorter range than magnetism (see *e.g.* Schroedinger, *Nature*, 1944, *153*, 574), then, according to the hypothesis, emotion is of much shorter range than intellect. Thus emotion is here supposed to be the prime factor ultimately responsible for the formation and concentration of the rest mass of the body (formed almost entirely in the long wave-change) of an event, whilst intellect is supposed similarly to be responsible for the production of the extensiveness of the space-time of the body and field (produced almost entirely in the short wave-change) of an event. It is for this reason that, although the factor of intellect is at a maximum at the end of half of the long wave-change yet, the intense and body concentrating factor of emotion being then momentarily non-existent, the proper wave-system, binding together the constituent parts of the event, is rapidly dispersed and the event as such 'dies'.

The above would be true for all events, but not for the universe which is without time and space (p. 131). But with nebulæ there would be this difference, that, at the 'death' of a nebula, there must be complete disruption and dissolution into photons (and cosmons). This is the present interpretation of the appearance and existence of *supernovæ*. With any other complex event the control of the nebula over the event, that is to say, the unity of the nebula, varying with its phase, will ensure that such complete disruption of the event will not occur. Thus only the *proper* wave-system of the complex event will disappear; the event itself will then be no more, and will 'die'. But some of the more stable (stability varying with the nebular phase) and 'long-lived' constituents will remain, as for example, the bones and skeleton of a man, or the wood of a tree. This would explain the comparatively quiet death of a man or of a tree, compared with that of a nebula, or even of some stars, in nebular phases of low stability.

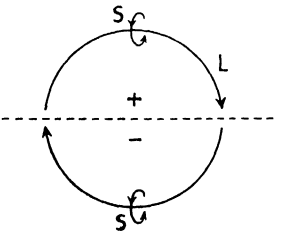


Figure 4

The time or orbital (L) and space or spin (S) wave-change components of a particle determine the contributions, labelled L and S, respectively, made to its wave-path.

S is at right-angles to L.

S is the particle spin-path.

L is the orbit of the particle.

The integration of the time and space wave-changes produces the negative or positive polarity of the event.

A left hand helix curve wave-path may be supposed to correspond to negative polarity of an event.

A right hand helix curve wave-path may be supposed to correspond to positive polarity of an event.

The geometrical analysis of the path of any isolated event, even of a photon, would reveal this as being 'curved', as has been explained. Any substantial space-time, or mass-space-time, is curved, *but in this sense only.* According to our space-time theory substance resides in three mutually perpendicular *planes* so that *substantial space-time is geometrically straight.* This is the basis for the existence of any substantial absolutely rectilinear line.

The path of an isolated photon will be 'rectilinear' in the normal practical usage of the term because the radius of its orbit is enormously great compared, for example, with that of the orbit of the earth around the sun. The term 'rectilinear' would then be seen to be derived from the so-called rectilinear propagation of light. But man can only 'know' of this rectilinear propagation, according to the present sensum theory, because

of the absolutely rectilinear (page 109) projection or propagation of his cognitive field processes (sense-field). However, a line would, or would not be, rectilinear for 'practical' purposes, depending on whether or not it would coincide with the path of an isolated or free photon.

Advantages of the new picture of the wave-particle nature of a fundamental particle

The present picture of a "fundamental particle", arising directly out of the hypothesis, may appear complex, yet the space and time wave-changes give the usual spin and orbit of a scientific "particle". The following advantages which it possesses should also be borne in mind: (1) the wave-path of the "particle" is described simply and this has not previously been achieved; (2) it removes the need of an "elastic medium", the luminiferous æther, because the psychic factors themselves are undulatory; nevertheless, the proper wave-system comprising all photon events and, together with nebular and cosmon proper wave-systems constituting the universe, might be supposed to require a name—a proper name such as is given to an individual man; this could well be 'the aether'; (3) it interprets the "spin" of a particle", this being composed of the two quarter-period out-of-phase duplex processes of the space wave-change, which allows of a natural sinusoidal reversal of the polarity of the magnetic and mesonic factors and of the two components of the electrical factor once during each 'period' of this wave-change, the spin change being incorporated into the "particle's" orbital change, either for "photons"—and this is interesting ("neutrinos" are here regarded as complexes of "photons")—or other "particles" which agrees with what is known by physicists; the spin of more complex "particles" would be more complex, since it would incorporate the spin of the simple constituents; (4) it is in agreement with the modern electronic theory of matter (sensa) since any "electron" will have a constant rest mass and electrical charge (Appendix II), the magnetic and mesonic factors, varying in magnitude as the "particle" moves (the short-range or mesonic factor

normally being unobserved because it is of short range and hence disregarded) so that the mass and "substance" of the "electron" will appear (wrongly) to reside solely in its electrical charge or in its electromagnetism; (5) the picture could be reconciled with the quantum theory and wave-mechanics theory (page 223) on the one hand and with relativity theory and field theory (page 139) on the other; (6) it would be in agreement with the de Broglie wave-equation and with Heisenberg's Principle of Indeterminacy (Appendix 1); (7) the fundamental constancy associated with the flux of all isolated events would be explained by the ubiquity of Planck's constant in "events" (Appendix 1); (8) it would attribute a life-period to all events this being due to the time wave-change; (9) it would interpret the relationship of the "electron" to the "photon" (Appendix 11); (10) it would help to explain the rotation of the plane of polarised light, and the relationship of polarised light to optically active chemical compounds and crystals (page 174) and (11) the mass-energy relationship $\epsilon = mc^2$ can be derived independently of Relativity Theory (p. 224). Therefore it is felt that although it may appear a complex picture of a "fundamental particle" it is yet an adequate picture.

The earth's rotation and orbit of revolution

The 'union' of two particles will be supposed to occur through the 'interaction' of their respective space and time wave-change components, that is of their spin and orbital components. This would generally interpret, according to accepted scientific principles, the formation (from electrons, positrons and mesons, etc.) of nucleons, atoms, molecules, and of larger complexes such as crystals, organisms, and 'heavenly bodies'. However, whilst in atomic and molecular systems or events the polarised short-range fields of the orbital wave-change component of any event would be dominant, that is to say, the relatively strongly polarised volitional (electrical), intellectual (magnetic), and emotional (mesonic), fields; yet, in astronomical systems or events, the extensive, rapidly oscillating non-polar 'gravitational' fields

(Appendix III) comprising all three (undifferentiated) factors, of the spin wave-change component of any event, would be mainly operative.

The circular orbital (and spin) motion produced by the flux, within the constancy of the resultants, of the three factors of one particle, is here supposed to be similar to the circular orbital (and spin) motion, produced by the flux within the constancy of the three pairs of factors, of two interacting fundamental particles. These three pairs of factors, on the union of the two events, do indeed become the three factors of one complex event, which may then rightly be compared with those of the single fundamental particle.

The rotation and revolution of the earth may be explained according to this aspect of the hypothesis. The rotation of any terrestial particle would be due to the constant magnitude of the effect of the 'gravitational' field (Appendix III) of the whole earth on that of the constituent particle, *i.e.*, to the union of the two in the one event. Instead of the particle path being more rectilinear, as it would be if isolated, it would then become more curvilinear, owing to union with the earth, and assume locally the *appearance* of the path of an isolated particle, (Figures 3 and 4), having relatively large amplitude for the spin wave-path, (S'), but still possessing a much greater amplitude for the orbital path, (L'). It is important at this point to note that the speed v_{s_1} of the particle when united in a larger event will be *less than* c because S' here is merely a deviation from the orbital path of the isolated particle. If the earth were isolated, then from Figures 3 and 4, its axis of rotation could also be regarded as the mean terrestial path, OA (Figure 5), corresponding to L in Figure 4. Neglecting all aberrations due to 'life', etc., the path traced out by each particle would be a helix curve of axis, OA. Neglecting all effects due to the moon, the planets and other 'heavenly bodies', the orbit of the earth around the sun would correspondingly be due to the effect of the 'gravitational' field of the sun on the earth. Thus the axis of rotation of the earth would be displaced from that of its actual 'orbit' and the path of each

terrestrial particle would appear to be a distorted helix curve. The earth's 'orbit' would be a helix-curve path of revolution around that axis, which is the path of the sun. The path of the sun would also be reciprocally displaced in a similar manner by the earth (and the other planets) from what would otherwise have been its path, so producing a relationship of terrestrial (S') and solar (L') paths, approximately resembling that of Figure 4, but distorted because these are deviations from what would otherwise have been the undeviated paths of earth and sun. This picture of the earth's motion, having been simplified as stated, is to that extent erroneous. In addition, the sun, as a constituent star of the galaxy, moves in a circle within, that is, relative to the centre of the galaxy, almost as does one terrestrial particle within the earth. But the sun moves in a helix curve within the universe, the helix curve being one strand of the helix path of the nebula. The 'axis' of the latter, like that of an electron, must, however, be presumed to be a semi-circle of very small radius, relative to that of a 'free' photon.

The Earth's Rotation and Orbit of Revolution

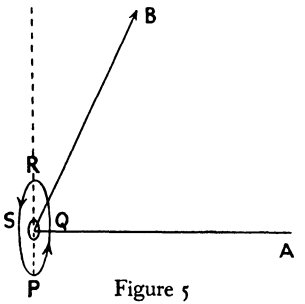


Figure 5

PQRS represents the rotation of one equatorial terrestial particle; the plane of rotation is at right-angles to the page; it represents the *earth's rotation or spin path.*

OA represents the direction of the earth's orbit as it would be if the earth were isolated; it is the *earth's axis.*

OB represents the earth's orbit as modified by the sun; it is the *earth's orbit of revolution* around the sun.

By the main hypothesis, events have existence in one substantial universe. This is three-factorial in that it involves three prime psychic factors, and multi-dimensional in that any prime psychic factor may be oriented in any one of the incalculably large number of directions open to it in the universe. Each factor would be oriented in this manner in the similarly large number of three factorial but four-dimensional events contained in the universe. This would explain how it would be possible for myriads of three-factorial polarised particles to occupy one and the same three-factorial and yet multi-dimensional Universe. Such an explanation is required for the present interpretation of the wave-particle nature of a particle, the particle-centre moving on its wave-path and the particle wave-changes being regarded as substantial, so that the wave-path is not *merely* a mathematical wave of probability, but is related to the particle's inner nature and personality. The group behaviour of particles of the same species, at different phases of their life-periods, and associated with slightly different energy quanta, would however be capable of analysis and description, in the modern scientific statistical manner, by *wave mechanics* or by *quantum mechanics*.

From the astronomical scientific evidence of an incalculably great number of "nebular regions" outside our own nebula, the Galaxy, there will be supposed to be an equally large number of tremendous events or nebular 'space-time' regions within the universe. In each of these nebulæ there will be minor events, nuclear wavelets within and typical of this major wave; namely electrons, and positrons, and all others composed of these, for example, mesons, nucleons, atoms, molecules, organisms, and 'heavenly bodies', contained, not as separate events, but as participating constituents. In each nebular event there will be an integration of the two kinds of oscillatory change, one of high frequency and the other of extremely low frequency. The low frequency (like the high frequency) change must also be supposed to be of alternating polarity due to the alternating polarity of the factor of emotion. The polarity of the factor of reason is

supposed to be so diffuse as not perceptibly to affect the polarity of either change, S or L, although the magnitude of this factor (and thus its polarity) is at a maximum when that of emotion has vanished. It would follow that the polarity of a nebular event or region will be periodically reversed, positive and negative polarities occurring alternately. This must involve (Appendix III) the sudden expansion and disruption of the nebula which will therefore 'die' at the end of one long half wave-change giving rise to new kinds of events which are 'straight' whereas the nebula is 'curved'. But a nebula of opposite polarity, will rapidly arise at the beginning of the next long half wave-change. Smaller events within a nebular event, being relatively short-lived will also have a uni-directional time-change, this direction being that generally of the nebula. There will thus be two major varieties of nebular space-time, these being asymmetric and either positively or negatively polarised.

The universe must also be supposed partially to consist of an indefinitely great number of major events of a second and 'straight' kind. The integrated 'high' (S) and 'low' (L) frequency wave-changes of these will be supposed to constitute one kind of major phase 'the æther' of the proper wave-system of the universe itself, another kind being that of nebular events. 'Free' photons of all energies will be the minor events, nuclear wavelets within, and typical of, this second and 'straight' kind because the orbital path of a photon when relatively unaffected by a nebular event, is much more extensive than that of an electron (whose orbit when 'bare' is negligible) and is supposed to be of cosmic order. The terms 'straight' and 'curved', used here to describe these two major kinds of events or phases within the universe signify respectively that the orbits of free photons, the particles of this kind of straight space-time have a relatively enormous radius of curvature, and that the orbits of bare electrons, the particles of 'curved' space-time have a small radius of curvature.

Finally there must be supposed to exist a third kind of major phase—the cosmon phase—the typical minor event being a new kind of particle, here called *the cosmon,* having phase angle $\phi=0$,

and almost infinite orbital speed. It is thought to be responsible fundamentally for the phenomena of *cosmic rays*. Our development of the general hypothesis compels us to postulate the existence of this third kind of major phase in the universe since any photon, being always polarised like any other event, must die. It must then give rise to a neutral particle—the cosmon—before it can be supposed to be transformed into a new photon of opposite polarity. The transformation from a photon of one polarity to the other will occur rapidly for reasons stated on p. 227. The cosmon, although neutral, because $\phi \sim \theta = 0°$ is yet polar because it possesses space-time extension and direction.

The same value (c) of the orbital speed of all 'free' photons in 'the æther' is here supposed to be due to the constant value of the angle representing the fundamental particle phase, the phase angle, $\phi = \pm 45°$ (p. 224) for all isolated photons. For a 'bare electron' the constant value of the phase angle is $\pm 90°$ (p. 224), the orbital speed is almost zero, whilst the nebular phase of the universal event has maximum asymmetry of one kind. The cosmon phase has maximum asymmetry of the opposite kind.

The integrated wave-changes of all major events, either 'curved' or 'straight', are supposed to be out of phase with each other so that there is a statistical averaging of exactly equal numbers of the indefinitely large number of possible groupings of corresponding pairs of positive and negative polar phases, the phases being those of the individual major events. Thus the universe composed of these ultimate constituents will be supposed to have all the dimensions and therefore no overall time dimension of one or other polarity, which also means no overall spatial dimension of one or other polarity. *The universe, although substantial, will be without time and space*, and therefore cannot be an event. It will be quite and absolutely stationary in itself. It will also be overall symmetrical. *The universe will provide the substantial stationary background against which all events may be viewed.* The compact bodies of nebular events may move within this because of the 'emptiness' provided by the 'straight' cosmon and photon phases. The path of a nebula, like that of a photon,

will be helical or spiral, but where the 'axis' is a semi-circle of relatively small radius, and where the 'spin' wave-path provides the observed amplitude. The high-frequency universal wave-change will be nothing more than the high-frequency (S) changes of all the major events and of all the small events within them. The low-frequency (L) universal wave-change will likewise be nothing more than the low-frequency changes of the major events and of all smaller events within them. The unique characteristics of these two component wave-changes, as described above, may once more be noted as they provide no overall polarity. Finally, the high frequency and low frequency universal wave-changes will together wholly form the therefore non-transcendental but wholly immanent proper wave-system of the conscious personality of the universe.

From this discussion it would follow that 'straight' and 'curved' major events do loosely unite with (interpenetrate) each other. Hence cosmons and photons may associate with electrons and other fundamental particles. Electrons, photons and cosmons are regarded as being only different phases of the same kind of—the most primitive—fundamental particle.

The Problem of Entropy

From this description of the universal hierarchy of events within the universe, this having three kinds of constituent major phases, and smaller events within these, it is now possible to provide a solution to the *problem of Entropy*. Entropy can be related to the irreversibility of a system. Any system except the universe may be regarded as an event. Entropy must therefore be related to the unidirectional temporal change of any event because on present theory this is the irreversible change within an event. The immediate implication of the theory therefore is that the problem of entropy, the eventual 'running-down' of the universe would disappear (although it would apparently exist within any one nebular event or region), because the universe is supposed to be completely and entirely reversible in all its phases and is without time.

The Cosmic Retardation of Light

The sudden change in mass-space-time characteristics on proceeding from *photon to electron* (see Appendix I), is supposed to occur at the beginning of the long half wave-change of a nebular region or event (page 129). Then the photons, of the 'straight space-time' of this locality, will suddenly be incorporated into the 'curved space-time' of the nebular event. This nebular 'space-time', like that of all other events is supposed to undergo very rapid change at the commencement of the long half-wave-change and then to settle down into a very slow rate of change (Appendix III). Thus the particle, previously a photon, and now a constituent part of the 'space-time' of the nebula, is changed into an electron or a positron, depending on the incipient polarity of the photon. The electrical charge on the "particle" will become obvious for the first time (see Appendix II). Only in this phase of a nebular region or event will a photon usually become an electron or positron. An electron, like any other event, is normally loosely combined with a photon or energy quantum and may be capable of motion relative to the containing nebula. The polarity of an electron or positron, once formed by the integration of the space and time wave components, is not affected by its direction of motion (Appendix IV).

Any photon, which is not retarded in this manner by a nebula to produce an electron is nevertheless considered to be retarded to a very slight extent. The very slight retardation is here supposed to be due to the universal relatively weak, but all-pervasive, spin or gravitational change, which helps to hold all the constituents of the universe together. A 'free' photon only, of all events, can be slowed down by its union with any nebula, the nebula being simultaneously speeded-up, in the same way that a 'free' photon is slowed-down when united with a 'bare' electron to give an 'ordinary' electron, the 'bare' electron being simultaneously speeded-up (Appendix I). The first statement appears to be absurd, but not when large numbers of photons are engaged. These are two instances of Newton's third law: 'action and reaction are equal and opposite'. In consequence the universe

as a whole will remain steadfast during all changes of its constituents. This is in keeping with what is required by the hypothesis. The small retardation of light will be called the 'cosmic retardation of light'. It is taken to show the union even of 'free' photons with the other constituents of the universe and also the overall unity of the latter, 'cohesion' occurring between all events, including the so-called 'free' photons—those moving in 'photon' space-time. Partly because of this, space-time even when composed only of photons, is slightly 'curved'. A free photon, in addition, is in itself a 'curved' space-time, so that on two counts photon space-time is 'curved'. In all other circumstances, with the exception of cosmon space-time, the 'curvature' is greater than the slight 'curvature' of free photon space-time. The cosmic retardation of light can be calculated in terms of the usual units of space and time of science. Before calculating this we shall briefly describe the Red Shift Phenomenon.

The Red Shift Phenomenon

Light reaching the earth from extra-galactic nebulæ is perceived by observers to 'be' more red than usual and it is thus said to have shifted towards the red end of the spectrum, that is to say its wave-length has increased. The effect is proportional to the time or distance travelled, but is independent of the wave-length of the light. This is termed the Red Shift Phenomenon.

Present theories to account for the Phenomenon, since it has all the characteristics of a Döppler effect, caused by a velocity of recession, postulate the recession of the nebulæ from one another and from our own galaxy (see for example F. Hoyle: *The Nature of the Universe*, 1950). They involve the idea therefore of the expansion of the world much as a gas expands. There are several theories, two of which may be mentioned, the first that of Eddington, based on Einstein's gravitational theory, which involves what Eddington calls a force of cosmical repulsion depending on, and proportional to, a cosmical constant. This theory is that of a world expanding under the dispersive force of cosmical repulsion which increases in direct proportion to distance and has then

become dominant over the ordinary attractive force of gravitation which decreases rapidly with distance. The second theory is that of Professor E. A. Milne and is a kinematical theory in which the idea of time is the main basis since, according to Milne, human observers have an intuitive notion of the lapse of time, but not of distance. By postulating an initial state of maximum closeness of nebulæ regarded as particles, then, if they were at that point or centre endowed with their present speeds of recession, those with highest speed would by now have travelled farthest. In this way we obtain a distribution in which speed and distance from the centre are proportional.

Originally attempts were made to explain the phenomenon by ascribing it to a retardation of light during its passage to the earth. This seems reasonable for then the decrease of velocity could be proportional to distance, or to time as commonly measured, which is the observed relationship. The idea was abandoned because there did not appear to be any satisfactory way of conceiving this. However, it is the interpretation now offered, based (in scientific terms) on our new theory of motion and related essentially to the unity of the universe, and therefore to the Newtonian gravitational constant, G, involving union between all constituent parts.

For purposes of calculation the cosmic retardation of light will be symbolised g. Assuming that the 'mass' of the whole universe is situated at its centre and that the photon whose motion we are considering is at its periphery, and assuming also the values given to the universal 'mass' and 'radius' by Eddington (*The Expanding Universe*, 1944, page 67), then, adopting the current conventional scientific units of mass, space, and time, we derive the value for g as follows:—

Radius of Universe, R $= 1068$ million light-years.

Total mass of Universe, M $= 2.14 \times 10^{55}$ grams.

Newtonian constant, G $= 6.67 \times 10^{-8}$ cm^3 gm^{-1} sec.$^{-2}$

$$\text{Now } g = G.\frac{M}{R^2}$$

$$\text{Therefore } g = 1.40 \times 10^{-6} \text{ . cm}^1 \text{ . sec.}^{-2}$$

If we accept the values $R \sim 2 \times 10^9$ light years and $M \sim 1 \times 10^{55}$ grams deduced by Dr. Whitrow (*Nature*, 1946, *158*, 165), then the value of the cosmic retardation of light becomes $g = 0.19 \times 10^{-8} \cdot cm^1 \cdot sec.^{-2}$

Because of the 'tangential' rapid drop of factorial intensities at or just beyond the boundaries of the bodies of events (Appendix III), and the negligibly small size of these bodies relative to their fields, and because of the more or less uniform distribution of nebulæ throughout the universe (see *e.g.*, "The Structure of the Universe", Spencer-Jones, in *A Century of Science*, 1951, page 165) it will be reasonable to suppose that the cosmic retardation of light is constant in value throughout the universe.

Since the photon path is 'rectilinear' we shall employ the simple Newtonian equation, for the retarded motion in a straight line, of any photon leaving a nebula which is 10^6 parsecs or 3.26×10^6 light years away from a terrestial observer, and having initial velocity c and subjected to retardation g. Substituting the appropriate values of g and t we obtain an equivalent decrease of velocity for the photon over this period of time of:—

$$gt = 1440 \text{ Km/sec.} \quad \text{(Eddington } g\text{)}$$
$$\text{and } gt = 191 \text{ Km/sec.} \quad \text{(Whitrow } g\text{)}$$

The *observed* range of values for what is usually called the 'velocity of recession' of the nebulæ, but is here regarded as the retardation of light, is from 465 Km/sec. to 851 Km/sec. for 10^6 parsecs. (McVittie, *Cosmological Theory*, page 10).

Now Eddington states that his values for the parameters "mass", M, and radius, R, may each be in error up to a factor of 2. The calculated value for the decrease of velocity of light, using his values of M and R, is approximately a factor of 2 of the mean observed value. The calculated value for the equivalent decrease of velocity of light, using Whitrow's values for M and R, is low in comparison. However, as with Eddington's figures, those of Whitrow are only approximate, for he gives M to be of "the order" of 10^{55} grams and R to be "of the order of 2×10^9 light-years." Here also, therefore, coincidence cannot be expected

between the calculated and the observed equivalent decrease of velocity of light. Yet the range of calculated values covers the range of observed values, and, if it were permissible to take the mean values in each case, we should obtain, respectively, values of 815 Km/secs. (calculated) and 658 Km/sec. (observed). The mean cosmic retardation of light, from the former figure, would then be 0.80×10^{-6} cm. sec.$^{-2}$. This value is taken to represent the value of the cohesion between one part (a 'free' photon) and other parts of the universe.

The Problem of Evolution

The problem of evolution is the problem of the emergence of novel kinds of events. This can be interpreted on the present hypothesis, as being partially due (see also page 197) to the changing phase locally of the universal event, causing continuously changing symmetry of constituent smaller events. The biggest evolutionary change from the present viewpoint will occur right at the commencement of a new polar phase of the nebular 'time' half-wave-change, for then its relatively extremely attenuated field of change, being originally that of the 'straight' space-time kind will suddenly alter to the compact body of change (Appendix III). This will be the necessary condition for the most primitive evolutionary changes of all, namely, that from photon to electron or neutrino to meson. Less primitive evolutionary changes, namely those from electrons, positrons, and mesons, to nucleons, to atoms, to molecules, to primitive organisms, to man, may be supposed to occur, owing to their becoming associated or united with photons within the time phase change of the nebula itself. Astronomical bodies will be formed concurrently with atoms and molecules. This will be followed later by *biological evolution.* Each solar system or star must be supposed to have the main space-time evolutionary influence on its constituents, always however, within that of the nebula.

At the end of one long half-wave of the nebular event its body, already partially dispersed, will suddenly disperse, with enormous

speed, and all existing constituent events will be as suddenly converted, via electrons (positrons), into photons and cosmons. This would not only interpret the occurrence of supernovæ, but it would also give *locally* conditions of the expanding universe kind. Many of the photons of that locality will later once again suffer evolutionary change into positrons and electrons as before at the commencement of the next long half-wave-change of the nebula; but with this difference that, where formerly the nebula was of say negative polarity, the electron then being more stable than the positron, the reverse will be true in the new long half wave-change of the nebula, as this will be of positive polarity. It would appear to follow that, since on earth the electron is more stable than the positron, the present phase of our own nebular event is of negative polarity. In nebular events of positive polarity atoms will have a negative nucleus and a positron 'cloud', in contrast with terrestrial atoms, which have a positive nucleus and an electron cloud. This would be an interpretation of a *universal process of 'continuous creation'*, but not as required by a continuously expanding universe mentioned by Mr. Hoyle. It would also provide a basis for the possible existence of 'matter' and 'anti-matter' (Jánossy, *Cosmic Rays*, page 6), which, could not easily, if at all, be distinguished spectroscopically from each other. The so-called irreversible hydrogen to helium transformation could no longer be regarded as irreversible.

Up to now it would appear that the solution which has been put forward to elucidate the problem of evolution is entirely mechanical. This appearance is deceptive for, in effect, the universal phase-change of either the 'creative' photon to electron process or the reverse process, would be a psychic event involving all three psychic factors. Similarly any process of union of events would be a psychic event.

Each event, be it cosmon, photon, nebula, electron, man, or any other organism, is an individual person, although appearances may be to the contrary. This is simply because each is, to some extent, its own substantial space-time, having its own powers of

will, intellect, and emotion, and, within the limits imposed by its own nature and by union within the universe and its constituent events, is a law unto itself.

The Hypothesis and Einsteinian Theories of Relativity and Gravitation

The main hypothesis would be consistent with Special Relativity Theory in so far as the latter is based on the constant speed, c, of free photons, and a four-dimensional space-time. This would, however, be either a nebular or a major photon space-time. With a second assumption of Special Relativity Theory, of a separate viewpoint, akin to a separate private sensual space-time, for each observer or 'reference system', the hypothesis would also coincide. But according to the latter there is an absolute universe having the unique characteristics of being without space and time.

We have supposed also that, excluding the cosmon phase which is exceedingly unstable and fugitive, there are two main *kinds* of stable limiting phases within the unity of the universe. These correspond to the orbital (L) and spin (S) changes of any event. Each phase exists in two *varieties*, one having positive polarity and being supposedly of the right-hand helix type, and the other having negative polarity and being of the left-hand helix type (Figure 4). The two kinds of stable limiting phases are (1) the space-time of the 'bare' electron and the nebula, and (2) the space-time of the 'free' photon and 'the æther'. The first is the limiting asymmetric phase ($\phi = \pm 90°$) and the second, the limiting symmetric phase ($\phi = \pm 45°$) of space-time. The first is the phase of space-time characterised by the quality of rest 'mass' (m_L) and is due to the factor of emotion (comparable to mesonism). It therefore corresponds to the orbital or time change (L) of any electron or photon. The second is characterised by the quality of 'energy' (ϵ) which is the inertial mass (m_S). It is due to the factor of intellect (comparable to magnetism). This phase corresponds to the spin or space change (S) of any electron, or photon. Each of these two limiting kinds of space-time itself

also has two polar phases, oscillation occurring between them as follows:—

positive electron phase	⇌	positive photon phase	⇌	neutral cosmon phase	⇌	negative photon phase	⇌	negative electron phase

There will be intermediate phases between these main phases, but they will only be produced in general by the association of the main phases. The limiting phases, as explained previously, are considered to be produced quite suddenly and (with the notable exception of the cosmon phase) to be relatively stable over long periods. Depending on the proportion of the main phases involved, the motion of an event, as commonly measured against standard space time units, will be proportionately rapid or slow. But the orbital speed, v_L, of all events except a free photon and a cosmon will be less than the orbital speed c, of a free photon.

Within any one factor of an event, the space and time dimensions are comparable to the spin and orbital dimensions of the whole event, because the spin and orbital components of an event have been shown to be its space and time components respectively. When a factor undergoes phase change, owing to fluctuation in the value of the phase-angle α (S-change) or β (L-change), then its extension is at a maximum when the mass or substance of the factor is at a minimum, and *vice versa* (see Appendix III). Assuming for the moment, however, that the substance or mass of the factor *is* constant, then it follows that the rate or speed of change is proportional to the ratio of the spatial to the temporal dimension and is greatest when this ratio is greatest. The component masses of a factor suffer continuous sinusoidal phase change owing to a continuous change in the value of either the angle α or the angle β. The mass of an *isolated event* does not suffer any comparable change because of the constant manner of integration of the spin and orbital changes as shown by the constancy of the phase angle ϕ. Thus the component masses, namely the inertial mass (energy) of spin change, and the rest mass of the orbital change are also constant. But when phase change of the

event as a whole, corresponding to change of ϕ, does occur, either because it is no longer 'isolated' or because of change of phase of the controlling nebula, then it will be supposed that the maximum speed of spin change will correspond to minimum inertial mass, m_s, (energy); and the maximum speed of orbital change to minimum rest mass m_L.

The ratio of the spin to orbital speed of change $v_s/v_L = 2\pi r/\lambda = \tan\theta = \tan^2\phi/c^2$ (Appendix III). The two limiting values of $\tan\theta$, namely infinity and zero, are obtained when θ has values of 90° and 0° respectively. The value of 90° for θ would be satisfactory for the bare electron, whose orbital speed is or approaches zero. The value of 0° for θ would not be satisfactory for the free photon, whose orbital speed although very considerable is finite, namely c. From our theory (p. 224) there is another actual speed of change equal to 1/c associated with the photon having this value just because its orbital speed of change is c. This speed is here considered to be that of the spin change. The value of θ for a free photon is thus just more than 0°; and this value of $\theta = 0$, is attributed to the cosmon. Other details of the derivation of the mass-space-time relationships of the three fundamental particles will be found in Appendices I and III. Thus it will be inferred that the following relationships hold good for the limiting phases of an event, where the *total mass* of the event is symbolised m_0 and where $v_L\, v_S = 1$.

	v_L	v_S	m_L	$m_S(\epsilon)$	ϕ	θ
Electron Phase	0	∞	m_0	0	$\pm 90°$	$\pm 90°$
Photon Phase*	c	1/c	~ 0	$\sim m_0$	$\pm 45°$	$\sim 0°$
Cosmon Phase	∞	0	0	m_0	0°	0°

* Our interpretation of the Red Shift Phenomenon would indicate that ϕ is slightly more than 45° and v_L always slightly less than c for a photon, whilst for an electron ϕ would therefore be slightly less than 90° and v_L always slightly more than 0.

From these tabulated differences of the characteristics of the electron, photon, and cosmon, phases a further important difference emerges. The values of the ratio v_s/v_L are strikingly different. For the photon the value is $1/c^2$ and for the electron it apparently approaches infinity and is certainly very large. It is the ratio between the equivalent magnitudes, that is, the natural units l and t of the spatial and temporal dimensions of an event. Thus, as for a *factor* of constant mass so for an isolated *event*, having constant mass because isolated, this ratio l/t is greatest when the ratio of the spatial to the temporal dimension is greatest, being this ratio. In this manner it is clear that the ratio of the natural units of the spatial to the temporal dimensions is greatest for a 'bare' electron less for a 'free' photon and least for a cosmon. The two particles, the electron and the photon, are regarded as being the stable limiting phases of the same fundamental particle, which reflects in its phase changes, the universal phase changes of the nebular and aether kinds, of the locality. Thus the two 'particles' would have the same mass or substance, this being differently disposed (see above).

It follows that the transformation of a 'bare' electron ($v_L \sim o$) to a free photon ($v_L = c$) involves *time dilatation* and *space contraction* of the particle. Concurrently the rest mass m_L is converted into the energy ϵ (which is the inertial mass, m_s) of the photon phase of the particle. This change is the prototype of the mass-space-time changes in the bodies of all events (each of which is composed of these fundamental particles) as the velocity v_L increases. That a transformation of the particle occurs in the prototype changes is merely incidental. It must occur in this instance so as to provide the required increase in velocity from the internal resources of the particle itself. But where the velocity increase is derived from external sources, the rest mass, m_L, is retained. Hence the *increased inertial mass*, m_s, helps to increase the total mass as v_L increases. The changes in the value of the ratio of the natural units of space and time, that is the change in the value of the ratio v_s/v_L which is also m_L/m_s would also occur in the body of any event as described for the prototype

change. These changes are absolute changes in events and are not those appearances of change, the changes of sensa, dealt with in Special Relativity Theory.

The present theory would claim that *absolute* changes of inertial mass, space, and time, occur in both the event and each observer, who is also an event, corresponding to changes in their absolute speeds and therefore in their relative speed (v) of motion. In other words, it is here maintained that experimental results, such as the time-dilatation of events revealed in Dr. H. E. Ives' experiments (*J. Opt. Soc. Amer. 28*, 215, 1938), the deflection of light in a gravitational field, the motion of the perihelion of mercury, etc., rest upon the absolute changes of the magnitudes of the mass-space-time units of events, corresponding to their changing phases, as viewed against the absolute and constant background of the universe. Reconciliation of the Lorentz Transformation (and to that extent of Special Relativity Theory) with the present absolutist interpretation is effected on p. 234. This would show the natural unit of length, l (indicating space-contraction) to be proportioned to tan ϕ/c, whilst the natural unit of time, t, (indicating time-dilatation and increase of inertial mass) is proportional to the reciprocal of this quantity.

Acceleration and retardation may be considered to be due to changes of phase of space-time; whereas constant velocity is due to the continuing sameness of phase of space-time. The Newtonian concept of 'force' producing change of velocity, would be abandoned. Acceleration would be supposed to be effected in an event composed of electrons (positrons) in two ways: (1) by its close union with more photons; (2) by its being situated in any of the kinds of field represented in a sense-field by gravitational, electrical, magnetic, and mesonic "fields". There is no need further to consider the first method of inducing acceleration, but the second method merits some attention.

From the description of the 'gravitational' field of an event in Appendix III, the field potential at one point is the measure of the tendency for motion set up by the rapidly alternating polarities at that point, that is by the dynamic equilibrium between

those indiscernible polarities of the rapid short wave-changes (S), the spin change, of the event. This is so, because the potential denotes the local measure of the reversible change into the intermediate phases of spin 'straight' space-time (comparable to orbital 'straight' space-time, *i.e.* cosmon and photon space-time) from spin 'curved' space-time (comparable to orbital 'curved' space-time, *i.e.* electron and positron space-time) in the oscillating field at that locality. It thus denotes the tendency for uniform motion of another gravitating event, also having a gravitational field, and which can be supposed to be situated at that locality. There is rapidly alternating bipolarity at each point, not only in each gravitational field, but also in each gravitational event, gravitational change being spin-change. *The direction of motion* of the body of each event will always be towards the body of the other event, because the potential gradient in the field of either event will always be greatest—and so will always dispose the other event to move—in the direction of, and up to the surface of, the body of the first event. That is to say *attraction*, without any repulsion, will be characteristic of gravitational fields and events. In this way the gravitational *potential energy*, existing at any point of a field because of the two spin 'curved' space-time phases at that point, may be transformed into the *kinetic energy* of the spin 'straight' space-time phases. The term '*potential difference*' signifies the *difference* between the potentials, or degrees of a tendency for uniform motion, at two points situated in the field. The universal prevalence of the Newtonian constant, G, would be due to its being related to the spin-change of the electron which is the same as that of the positron, of which two particles all ordinary complex events are here supposed to be constituted.

Gravitational acceleration is therefore due to the differences of potential at different points in a gravitational field. Points of the same potential, situated within the four-dimensional field (see page 115) of an event, may theoretically be joined to form contour lines and so the curvature of the terrain, the field, would be entirely geometric. The curvature would be that derived

from measurable velocity changes and would not be curvature inherent in substance. This would be consistent with Einsteinian gravitational field theory, in that gravitational acceleration would be related to this geometric curvature. Nevertheless, this curvature merely represents underlying differences in substance, the different tendencies for undergoing the rapidly reversible spin change at different points in the substance of an event. Thus space-time, in spite of modern gravitational field theory, would always be substantial. Moreover, according to our hypothesis, space-time is not only always substantial, but is also always geometrically straight, since the substance resides in three substantial mutually perpendicular 'planes.'

The curved path (curvature) of an isolated substantial particle (Figure 3) is obviously not due to or 'caused by' (see page 104) potential differences in the fields and bodies of two events, but it is due to or 'caused by' potential differences—changes of phase—in its own spin and orbital components. In this way the wave-changes of *strictly geometric curvature* (see Figure 3) of a *quantum particle*, either a photon (kinetic energy quantum of inertial mass, $m_8 \sim m_0$) or an electron (potential energy quantum of rest mass, $m_L \sim m_0$), may be related to the strictly geometric curvature of *field theory*. The particle, like the field, may be regarded as being four-dimensional as is indicated on page 115.

An explanation similar to but in a way different from that given for non-polar gravitational fields is given for the field potentials and general properties of the polarised electrical, magnetic, and mesonic fields in Appendix 111. The last-named, however, being an uniquely intense, near-body kind of field, will involve further considerations which lie outside the scope of this book. 'Repulsion' and 'attraction' must be considered briefly for these polarised fields; in other words, *direction of movement* in a field, as well as mere movement. Repulsion, say between a positive event (body) in a positive field not its own, would be due to the greater geometric curvature (marking the difference of field potentials) *away from* the locality which is occupied by both event and field, since they are both positive.

The event will tend to move to the point of the lowest positive potential. Placed in a negative field, a positive event will tend to *move towards* the point of highest negative potential and for the same reason. It tends to follow the line of maximum geometrical 'potential' curvature of the field in which it is situated. Generally 'potential energy' is to be identified with the phases corresponding to the stationary conditions of events and is inherent in 'curved' space-times, whilst kinetic energy is to be identified with phases corresponding to the rapid movement of events and is inherent in 'straight' space-times. The space-times of the *fields* of events are further considered in Appendix III.

As in special relativity theory, the space and time of visual sensa were found to be relative and essentially conjoined, so the present hypothesis of events would show that mass (or substance), although absolute, must be indissolubly bound as space and time in mass-space-time, being itself the substantial space-time of events.

Universal Law and Order: Universal Mechanics

According to the hypothesis, the conception of 'force', and of 'fields of force' used in describing the scientific fields of electricity, magnetism, mesonism, and gravitation, is false. All that happens, in a private scientific or sensual world, is the representation there, of the causation of true energy and power within the universe and residing in the psychic factors of personal will, intellect, and emotion. The denial by Positivists of the existence of causation (excepting in the phenomenalist sense) in the universe would then be seen to be baseless. The sensa and "causation" of the world of science would merely represent events and causation in the universe lying outside the scientific world. Electrical 'energy' and 'power' would thus be *no* energy, and power, but merely representations within the private sense-field of any percipient of the energy and power of persons—electrons, protons, etc., residing in the Universe. Mechanical 'energy' and 'power', would likewise be without energy and power, and would be merely similar representations of the energy

and power of every kind of person. Scientific 'power' and 'energy' of all kinds—electrical, magnetic, electro-magnetic, (heat, light, etc.), chemical, and mechanical,—are apparently interconvertible because the apparent conversions represent real conversions of persons who are all at bottom qualitatively the same.

What is termed 'mechanics' would be seen to be merely the interpretation of representations, within any private world, and expressed in terms of the scientific factors, of change, which would be real change, between persons within the universe. This change would not be mechanical, if by 'mechanical' is meant that the beings undergoing the change are lacking in mind and spirit. It might, however, be termed 'mechanical', if, by this term, it were understood that real change is always orderly. Since this would be true, on our hypothesis, we may speak of *Universal Mechanics* in contra-distinction from any scientific mechanics. Universal mechanics would involve limited individual freedom within statistical law and order. Unlike Newtonian mechanics it would legitimately include the conceptions of energy and power but would exclude that of force. Unlike Einsteinian mechanics it would legitimately include one absolute substantial background for events although this would be without space and time. Thus these anomalies of the two systems of scientific mechanics used by modern scientists and engineers would be removed. The term 'mechanics' as used here would not, however, be associated with the apparently deterministic world of science, of 'matter', and gravitation, electricity, magnetism, and mesonism, but only with the orderly universe of mind and spirit, of will, intellect, and emotion.

Universal Law and Order: Memory and Instincts

Order, habits, instincts, as well as memory, equally within all constituent events as within the universe, are regarded here as being based on the undulatory or periodically repetitive and recurrent nature of all events. If we define *chaos* as order of low degree, then it may be supposed to be due to the cosmon phase

and also to the excessive inclusion, in an event, of photons which are more or less 'free'. These bring with them high motive power producing low co-ordination or union within the event. Order is due to electrons, and positrons of relatively low motive power producing a high degree of union and co-ordination within one event. *Instincts* are regarded as instances of memory within the universe (see also page 197); *habits* as instances of memory specific to the event possessing them.

Memory may be considered to be of two main kinds; that of the electron and that of the photon. The first kind of memory, based on the vibratory processes of the electron (positron) is revealed in *structure* and structural stability ($v_L \sim 0$, $v_s \sim \infty$), so that '*things*', *i.e. structural events*, may exist and endure. The structures are indeed relatively stable and stationary, undulatory processes of events. The second kind of memory is revealed in the *vibratory processes* of the photon where there is memory in movement or process ($v_L = c$, $v_s = 1/c$). Memory lies therefore in structure *and* in process, both being wave-like.

Order, instincts, habits, and memory, all lie not only within the vibratory processes, but also within the vibratory structures, of the proper wave-systems of events.

CHAPTER VI

LIFE

HAVING shown in the preceding chapter how the hypothesis is related to certain features of science and especially of physics, I shall proceed in this chapter to discuss its relevance to the biological sciences and in the next chapter to community and social organisation. It is my intention thus to provide support for it, first by demonstrating its coincidence with scientific evidence (although the interpretations which it offers are not always those now current), and secondly by the coherence of the solutions which it gives of outstanding scientific and general problems.

'Living' and 'Lifeless': Terms of Conventional Significance

From the basic conception of the hypothesis, it would follow that all persons, from the least energetic photon to the largest nebula, from the electron to the elephant, are 'alive'. Each is 'alive' because each is mind and spirit. However the terms 'life', 'living', 'alive', are more often than not applied to perceptual sensa, that is to say to the sensual representations of real persons and not to real persons in themselves. This application of the terms, *ex hypothesi* is wrong, for there can be no vitality in these 'thin' wraiths. However, to avoid misapprehension, we shall discuss the terms 'life' and 'living' from this standpoint also, that is as they relate to perceptual sensa. Now these are *all* integrated trinities of the scientific factors and all are basically qualitatively the same. When, therefore, we proceed as we shall in this chapter from the consideration of the simpler "events" such as "photons", "electrons", "mesons", "nucleons", "atoms" and simple "molecules", to the more complex "events" such as the large aggregates of organic chemistry, colloid science, and

the simpler 'living' "organisms", there is for us no such problem of *qualitative* difference as confronts those who suppose that all things can be put into the two classes of the living and the non-living, where 'life' and 'living' are thought to be of real and not merely of conventional significance. On the other hand, although all events are qualitatively the same and are in this sense alive, yet an explanation must eventually be found for what is, on any theory, a difference even though conventional, between the living and non-living. The explanation is, in brief, that the more rigid organisations and order and restricted range of behaviour of the simpler non-living events, gives way to the more flexible organisation and order, and wider range of behaviour, of more complex events, until the behaviour becomes that which is recognisable as typical of living events. The explanation is considerably amplified in this and the following chapter.

Any theory such as the present, which asserts the qualitative similarity of living and non-living events and the truth therefore not only of organic but also of inorganic evolution, must also face the difficulty that, although in the past on our earth, living things must therefore have been produced from the non-living, yet to-day this is nowhere found to occur. This also must receive an explanation, but for the present we shall consider the views of scientists and philosophers on 'life'.

Theories of 'Life'.

For Plato and Aristotle, that which distinguished the 'living' from the 'lifeless' was the presence in the former of a principle of life, called the 'psyche'. When death came the soul or psyche left the body, and a corpse remained, in appearance closely resembling the living body but in behaviour differing greatly from this. For Plato the psyche was an independent entity capable of active existence before birth and after death; but Aristotle's general position, although rather confused, seems to have been that the psyche and the body of a person were inseparable, so that death of the individual meant the dispersal of both. Neither the Platonic nor the Aristotelian theories of life are consistent

with the present hypothesis but the latter is the more nearly related to it in attributing a finite period to each person.

Descartes believed that whilst animals are merely highly complicated machines without mind, man is such a machine associated with a mind. Mind for Descartes was a thinking soul, capable of knowledge, and of conscious feeling and emotion, but mainly of intellectual action. The Cartesian mechanistic biology has had great success and may be said to have resulted in the modern biological theories of genes and organisers and of the scientific side of Dialectical Materialism generally, as applied to biology. However, although mechanical and physico-chemical explanations of biological processes must be regarded as correct so far as they go, in the end they are merely descriptive. By themselves these explanatory descriptions finally lead to insurmountable barriers.

To quote Professor Adrian (*loc. cit.*) more fully, he has avowed "the complete inability of contemporary science to give a satisfactory picture of any kind of mental activity. No one would deny that present inability. Yet the subject has advanced so much that the physiologist must go forward so far as he can, fitting his results into the framework of the physical sciences as long as the framework will hold them. He has still far to go along this materialistic path-way, but the impression which should be left is not one of failure. It will be no failure if we come to a region where our present models of physical reality will need some radical addition if they are to content us; and although this region may be a long way off, we can at least claim that our difficulties have begun to take on unusual forms. Although our present lines of advance may lead us astray they have at least begun to define some of the barriers. The final objective is to find out how the activity of the brain is related to that of the mind."

Adrian, like other scientists, on our view must be considered correct in prosecuting scientific investigation in a rigorously 'materialistic' or mechanistic manner. As he says there is no failure here. These accurately described scientific processes will provide

the wealth of data required for the later transmutation or stepping-up stage into the supposedly true explanation and understanding of these aspects of the universe, as has been explained. We may indeed say, if the hypothesis be correct, that, with its formulation, the 'region' mentioned by Adrian is not 'a long way off'; it is, in principle, here and now. It also seems inevitable that in practice the first steps in the correlation of the scientific with the psychological will have to be taken by correlating the "brain" processes of one man, as perceived by another, with the simultaneous conscious brain experiences of the first man. This general line of approach, which is being followed by Professor Adrian and his colleagues, should lead eventually to success. It requires the practical correlation of the "brain" activity of a man as shown by recordings, electrical or otherwise, with his simultaneous 'conscious' brain experience. The successful practical application of the stepping-up stage, arising out of the present hypothesis, to the wealth of scientific results already to hand, would depend on the possibility of finding fairly simple transformation formulæ based on the elucidated correlation of human "brain" processes and human conscious brain experiences. Modern investigations, on the 'electronic brain' and cybernetics, may also provide well-defined evidence of a fundamental character for this development of the hypothesis.

The 'psyche' of Plato and Aristotle, and the 'mind' of Descartes are particular instances of the general theory of *Vitalism*. Woodger has suggested the restriction of the term 'vitalism' to theories of 'life' "which postulate some entity in the living organism *in addition* to the chemical elements, C, H, N, O, P, etc., plus organising relations. This (suggestion is) only another way of asserting that organisation exists in the living organism, and that this organisation is not something fundamentally mystical and unamenable to scientific attack, but rather the basic problem confronting the biologist." (Needham, *Order and Life*, page 7). The position in Biology then would be analogous to the position in Organic Chemistry, as it is to-day, after the discarding of the "Vital Force" Theory, consequent on the publication of Berthe-

lot's *Chimie organique fondée sur la Synthese*, in 1860. Before that book appeared it was generally held that the chemical elements in organic, that is carbon, compounds were subject to laws quite different from those in inorganic nature.

Many biologists and physiologists, including Woodger, Needham, Sherrington, and Adrian, already reject the theory of Vitalism. For example, Sherrington (*Man and His Nature*, page 85) states that: "an energy system which we call 'alive' does not radically depart from energy-systems which we do not call 'alive'. Both are chemical." And again (page 86): "Life as a distinction between physico-chemical systems is a convention; convenient, but not scientific," or (page 86): "What we call by convention 'life' is then chemico-physical. Why not, then, say of other energy-systems than that of the 'cell' or of the body *in toto* that they have life? Why not say so of the rock as well as of the tree? Why not of the component molecules of the cell as well as of the cell itself? There is indeed no good ground for speaking of these as living, those as not-living. When Professor Blackett speaks of the mean life of the mesotron (meson) particle and the Insurance Office speaks of the mean life of ourselves his particle's behaviour gives him no less right to do so than does ours the Insurance Office. Each is an energy transaction which at some time ceases to be what it was. If a definition has to exclude as well as to include, it must lean on a logical boundary of what it defines; the term life has no such boundary from lifeless."

This modern view of biologists, physiologists, and biochemists, is in keeping with our hypothesis to the extent that there is only a conventional difference to be made between the 'living' and the 'non-living'. However, according to the hypothesis, any perceptual sensum or scientific 'object' as dealt with by scientists is merely representative of the thing-in-itself or the event. The perceived organisation of the perceptual sensum is a ghostly representation of the real organisation of the event represented. Indeed organisation mechanical, chemical, or biological, does not really exist. The perceived 'organisation' is without power and is a representation, which in itself is powerless.

The scientific viewpoint or interpretation can only be in terms of the three prime scientific factors, the electrical, the magnetic, and the mesonic, and the secondary complex factor of gravitation, which in themselves, and contrary to the common belief are quite powerless, being representations in the mind of the observer of the really powerful and causative psychic factors. Nevertheless, these conclusions of biologists on 'life' as a conventional term, so far as they go, do provide support for our hypothesis. The general principles of 'Vitalism' including Driesch's theory of *entelechy* would be rejected. That is, mind does not enliven body as a disparate entity, but *is* body.

Biological Organisation

From the qualitative sameness of the 'living' and 'lifeless' the solution to the problem of biological organisation, the big problem presented by the living organism, must, at least, qualitatively, be the same as the solution to the problem of the organisation of simpler events, such as electrons, atoms, and molecules. According to our interpretation this organisation or integration of the parts is due to the *proper wave-system* (possessing different energy levels, see page 70) of the whole. This includes the wave-systems of the component parts of constituent modified simpler events. Any change in the wave-system of the whole event will alter the wave-system of the component parts such as an electron or nucleon within an atom, or an atom within a molecule. The reverse is also true.

Applying this to biological organisation, it should follow that change within a man should modify the beating of his heart or the rhythm of his brain. The reverse should also be true, that is, the alteration of the wave system of the organ should affect the whole organism. Instances of this are quite well known. Thus a man may faint or 'lose consciousness' and so change his nature or character due indirectly to an alteration in his proper wave-system produced by a change in the wave-system or rhythm of his beating heart. The change in the man is immediately due to a change in the wave-system or rhythm of the brain.

Similarly, a change induced (as by electrical convulsant therapy) in the wave system or rhythm of his brain may cause an epileptic fit. These changes are of a gross kind. More delicate and subtle changes in a person's nature are those produced for example in an act of sense-perception. Then changes within the wave-system of a sense-organ produce changes in the wave-system of the brain and through this of the whole person. Thus biological organisation, like that of atoms and molecules, may be explained by the proper wave-system of an event co-ordinating the wave-systems of its constituents. This will be shown to provide a consistent interpretation of biological organisation.

In any kind of event, *the pure ego* can be taken to be the proper space-time wave-system integrating within it all the constituent events, but transcending them. Any proper wave-system or event is itself capable of existing reversibly at many different levels of consciousness, each depending on the phase of the life-period and also on the energy content of the event. In man, the proper wave-system of the cerebral cortex of the brain may be regarded as forming the basis of the conscious ego who experiences or *has* the conscious thoughts, purposes, desires, and emotions. It is the conscious ego who constitutes the person at the highest conscious level. However, the conscious ego, produced by a process of synthesis or integration from communities of the brain, is only a portion of the whole person, who is largely composed of 'unconscious' mind* and spirit.* The conscious ego is therefore influenced in his character by the unconscious organs, persons of mind and spirit (and reciprocally also affects them). Amongst these may be mentioned those persons (not sensa), the endocrine glands and their hormones, the sense-organs, the nervous system, the heart, the liver and so on. At death, the proper wave-system of a person will be broken or dispersed so that integration and organisation are lost and consequently the wave-motions of the specifically characteristic constituent organs

* Mind here signifies cognitive processes; though usually employed in this book to denote the whole event, *i.e.*, cognitive *and* conative processes.
Where the phrase "mind and spirit" is used then mind signifies cognitive processes, and "spirit" signifies conative processes.

may also cease, unless the organs are stable or unless special treatment is accorded them, as in tissue culture experiments.

The differences in the wave-systems, characteristic of the various organs of any person, may be supposed to have their beginnings in the differences of the wave-system of the 'ordinary' electron (positron) (Appendix 1). It is from this ultimate source of 'free' photon and 'bare' electron that differentiation of essential parts or organs probably arise within the unity of a person.

Biological Organisation: Restitution and Recuperation

If biological organisation is to be interpreted on the basis of proper wave-systems then there should be some scientific evidence in support. In general the rhythms peculiar to the brain, (see p. 71), heart, and other organs of a living man or animal, indicate wave-systems proper to each organ. Needham (*Order and Life*, page 117), has referred to the work of Vlès and Gex and this provides important evidence in support of our interpretation. They examined the transparent sea-urchin egg in the ulta-violet spectrometer and "obtained an absorption-curve which was not typical of the proteins, although these substances undoubtedly formed by far the largest proportion of the solid matter present in the eggs. Only upon cytolysis and the death of the cell did the charactistic protein curve appear—an indication that some curious structural state was present in the egg."

Our interpretation of this is that the wave-systems of the proteins and other components present in the living cell, are modified within the integrative proper wave-system of the whole cell in a way comparable to the modification of the wave systems of electrons and nucleons within an atom or of atoms within a molecule. It is the proper wave-system of the whole sea-urchin egg, which, harmonising more or less with the wave processes of the different photons of the ultra-violet light, assimilates or rejects them, more or less, according to their different natures and so gives rise to the observed absorption-curve typical of the living egg. When the integrative proper wave-system of the living egg is destroyed then the proper

wave-system typical of unmodified and 'free' protein is revealed through a different kind of absorption-curve.

The work on isolated single cells following the perfection of the micro-manipulator as an efficient tool and also described by Needham (*ibid.*, pages 117–119), can be interpreted similarly and gives further support. Miller's experiments on amoebæ with the narcotics ethyl alcohol, chloretone, and ether, disclosed that "although their action was marked on immersion, they had no action at all when micro-injected into the cytoplasm. In all concentrations chloretone increased the fluidity and streaming movements of the interior. Alcohol might cause a reversible coagulation. Still more remarkable was the result of Pollack . . . (the neutralisation of the picric acid by the base in the cell-interior probably plays a part here), who micro-injected solutions of picric acid and found that solutions which definitely coagulated proteins in the test-tube had no such action in the interior of the living amœba. Only if there was a local injury at the point of injection did the picric acid coagulate the protoplasm. In contrast to the non-toxicity of the reagent within was its extreme toxicity when applied to the external surface."

In these experiments the persons of the photons, of the ultra-violet light of Vlès and Gex, have been replaced by the persons of the molecules of the narcotics or of picric acid. When these 'foreign' molecules are injected in relatively small proportions, as is usual in micro-injection, that is when they are brought into close relationship with the amoeba, then they will be assimilated or rejected to a greater or smaller extent by the proper wave-system of the amoeba. The wave-system will be modified thereby as is evidenced by the perceived change of fluidity or rate of streaming of the interior of the amoeba. I am not here identifying the streaming of the interior of the amoeba with the proper wave-function of the amoeba because its nucleus, an important organ, does not stream, at least not at the same rate or in the same way. I am merely pointing to the perceived change of streaming of the interior of the amoeba as indicating a change in its proper wave-system.

The perceived reversible coagulation caused by alcohol can be attributed to the power of restitution of the amoeba due to its possessing a controlling wave-system. However, when the proportion of foreign molecules becomes excessive for the restitutive or recuperative power residing in the proper wave-system of the amœba, so that assimilation or rejection of them cannot be effected by it, then this system is not merely changed by the 'foreign' molecules or persons, but it is broken down or dispersed and the amœba is perceived to 'die'. The difference between 'food' and 'poison' for a living person may thus lie in the different degrees of harmony between the proper wave-systems of the 'foreign' bodies and of the living creature. The degree of harmony or tolerance will determine the limiting proportion of the 'foreign' persons associated with the living creature beyond which there is irrevocable change of the proper wave-system of the living person. Poison will have a low, and food a high, limit. They are however, in this sense, qualitatively the same. Because of the harmonious associative properties of food with a living creature the former can be assimilated in relatively high proportions and so either maintain the living creature or help in its growth and development. Food is discussed in more detail later in the chapter and from a different viewpoint.

The power of restitution or recuperation of a living organism as a person, here attributed to the vibrant quality of its proper wave-system, the *vibrancy being mental and spiritual* and involving will, purpose, memory, and intelligence, is well shown by the capacity of eggs "to develop normally after their contents have been thoroughly stratified by centrifugal force. The centrifuged amphibian egg, for instance, will show a mass of yolk granules at the centrifugal pole, a cap of pigment at the opposite one, and an intermediate transparent protoplasmic layer." (Needham, *ibid.*, page 147). All the most reflective embryologists seem driven to the assumption of a 'cytoskeleton'. Shleip states that "In every attempt at the explanation of polarity and symmetry in the egg, some as yet unknown property of the protoplasm has to be introduced. To avoid giving it any new

name which could only be arbitrary and tentative I will call it 'intimate structure' *i.e.*, a morphologically invisible, specific property of the cytoplasm, the manner of working of which we do not yet understand". In our view this intimate structure is the proper wave-system of the egg, involving 'process' (p. 148).

The power of restitution of organisms generally is also insisted on by Professor S. J. Holmes (*The Problem of Organic Form*, 1927), in the following passage: "It is perfectly plain that organisms must possess some power of regulation so that departures from the norm automatically bring about their own check. Any theory of development or regeneration which provides no explanation for this capacity of living organisms is obviously inadequate. Organisms can be thrown off the track of normal development in a thousand ways; yet, instead of continuing to become more abnormal, they get back sooner or later upon the right path. And their ways of getting back are multitudinous. If they are prevented from employing one method, they frequently use another. Organs are often regenerated by methods very different from those by which they were formed in embryonic development. In fact, organs arising from one germ layer may at times be regenerated from an entirely different germ-layer. The resourcefulness of organisms in attaining and regaining their normal form affords one of the most remarkable manifestations of life. It is a property which generally proves very disconcerting to the theorist."

A statement in a similar vein is made by Professor Lawrence Henderson on 'organic regulation' in his book *The Order of Nature*. "Sooner or later, when the problem of organic regulation is studied, we come upon the fact that a certain organ or group of cells accomplishes that which is requisite to the preservation of equilibrium, varying the internal conditions, in a manner which we can on no account at present explain. The same difficulty is encountered in the analysis of every other organic regulation of whatever sort. There is no physiological phenomenon of regulation, the autonomy of which we can to-day understand."

We have sufficient temerity to state that, in principle, the

present hypothesis does provide a basis for understanding the power of restitution and regulation of biological organisms. The real organisation and control lies in the integrative control of the whole organism by the proper wave-system involving the factors of will, intellect, and emotion, and represented in the scientific world as a mere image of reality, a kind of moving picture show of reality, displaying the 'wave-motion' of the factors of electricity, magnetism and mesonism.

The organisation of the biological cell is also referred to by Professor Stacey in the following passage: (*Proteins and Life*, 1948, page 125), "The evidence for the existence of a cell 'skeleton' is mainly inferential and rests on the difficulty in imagining how the manifold enzyme systems in the cell can operate without mutual interference, if they are not kept apart from each other by some framework within the cell. If the cell contents are mashed up, as in the preparation of tissue extracts, all the enzymes present begin acting on their substrates in an uncontrolled manner until, finally, even the proteins of the cell are broken down, little remaining but a heterogeneous assortment of relatively simple compounds. This process, known as tissue autolysis, also occurs after the death of the cell and it appears that the hypothetical structure holding the enzymes apart from the substrates in the living cell cannot be static, but must be maintained by the life processes of the cell. The fact that no such structure is visible in the cell does not mean that it is not present, but only that, if present, its refractive index and staining properties are so close to those of the remaining contents of the cell that it is not distinguishable. Examination of cells in polarised light has given some indications of the presence of structure in the protoplasm, but owing to the thinness of the cells examined, the information obtained is not detailed enough to be of value. More positive evidence has come from the examination of a mould of the order *Myxomycetes*, which apparently possesses no cell walls, and is, in effect, a continuous mass of naked protoplasm. It can flow through a mass of cotton-wool and emerge unchanged and even pass through parchment with holes of only 50 $m\mu$

diameter. Yet it can only pass through these small holes if left to itself. If pressure is applied to force it through, the mould is killed even when the holes are a hundred times larger."

The evidence provided here by Stacey for a 'cytoskeleton' or 'intimate structure' of the cell supplements that provided by the centrifuging of the cell mentioned previously. The present interpretation again is that the cell possesses a proper wave-system involving 'process' as well as 'structure' (see p. 148) and having components whose speeds of change, v_L and v_S, are the time and space velocities respectively of our theory. The wave processes of the parts will all contribute their quota to the proper wave-system of the whole being. The perceptible component of the proper wave-system of the body of a person will be given by the velocity of the time wave-change (v_L), whilst the imperceptible aspect will be represented by the velocity of the space wave change (v_S) as is true also of the electron. There would, then, be no intimate structure, as such, where 'structure' indicates a lack of fluidity in space and time, but rather there must be cell 'organisation', order and instinct of the kind involved in a proper wave-system (page 148). Sufficiently high pressure, the sufficiently high energy and power of other individuals, may be supposed to deform this wave-system as to disperse it, when death must occur. This would interpret the observations on the mould of the order *Myxomycetes* and also the observed effect of mashing-up, as contrasted with the centrifuging, of the contents of a living cell. Where the pressure on the living organism is not too high as in the centrifuging of the cell then the high flexibility and power of restitution of the wave-system of the living organism will be sufficient to allow of a return to the normal after the pressure is removed. Where the strain induced by the applied pressure exceeds a certain value then only partial restitution will be possible, when the organism will have suffered a permanent change, as is also true beyond the elastic limit for 'inanimate' beings.

The 'elastic limit' is known to all students of elementary physics from the study of the limits of applicability of Hooke's

Law. Beyond this value, for non-living events, the breaking-point is reached with a relatively small increase of stress. This is comparable, for the living cell, to the range between the conditions imposed by the centrifuging and by the mashing-up experiments. The fatigue or strain of a metal, for example of a rod of steel under 'tension', as observed in any private scientific world, is in this way seen to be comparable to the fatigue or strain in a man when under tension. Recuperation in each event is obtained by a period of rest from stress. The word 'strain' in science refers to the 'distortion' of an "event". But strain and fatigue are experienced by an event through the factors of will, reason, and feeling. The scientific terms "strain" and "fatigue" refer to the representation, in the observer, of the distortion in the event observed and such "strain" or "fatigue" can only be described through the prime scientific factors. It is not strain or fatigue, but only "strain" or "fatigue".

The difference between biological and physico-chemical organisation

Just as each modified or 'regulated' nucleon or electron, within an atom, is considered to have its own modified wave-system integrated within the proper wave-system of the whole atom, so each of man's organs, heart, brain, skin, and so on, is considered to have a modified wave-system integrated within the proper wave-system of a man. The beat of the heart, the rhythm of the brain, the peristaltic action of the stomach, the expansion and contraction of the lungs, the alternate contraction and relaxation of 'subconscious unwilled' muscular action, and the rhythm and fluctuations of all metabolic equilibria, are supposed to be regulated within the proper wave-system of a man. All these measurable wave-changes are electrical at bottom for science to-day (by the electron theory) and it is these which are of the velocity of the long wave-change, represented generally by v_L, which is always less than c. The simultaneous short wave-changes corresponding to these are of that range of velocity represented by v_s, which is much greater than c and the changes

therefore cannot be observed *via* sense-perception. They are the processes responsible in the brain *for* sense-perception, whereas the measurable changes are those of all types of bodily motion.

The integrative proper wave-system, of a complex organism or event, is originally that produced by the partial merging or loss of individuality, of the atoms and molecules and the bigger colloidal aggregates, which compose the original single germ cell from which the organism develops. This is comparable with the unity of an 'ordinary' electron, or nucleon, or atom, or molecule or colloidal particle, but as one proceeds from the electron along the series to more and more complex persons the union becomes more flexible. That is to say, the integrative influence of the wave-system of the complex person on the component parts is more flexible than that of a simpler person such as an atom on its component parts. Nevertheless, the proper wave-system of any person will have a unifying, and therefore, a regulating, modifying, and co-ordinating influence on all the component parts. The richness, variety, and complexity, of the personality of the living person, will only be attained through the great number, variety, and special functions, of the component parts woven into the proper wave-system. It is this gradually increasing richness and variety which will be supposed to give first of all the quality of life, then the consciousness of animals, and finally the self-consciousness of man.

Recently biologists have been converging on a common point of view, the principle that self-propagating particles, variously located, are responsible for both growth and differentiation. The problem, as they see it, is to determine "the relationships of these particles to one another, in position, in multiplication and in government." (Darlington, *Nature*, 1949, *163*, 44, reporting on a symposium on the "Growth and the Genetics of Particles.") Murray has found that, for multicellular organisms, the observed differentiation rate of cells and the multiplication or growth-rate are directly proportional, so that the greatest change of form occurs at the start of embryonic development, when the rate of growth is at its highest.

In the preceding paragraph the word 'government' is introduced. This word cannot possibly be interpreted in a non-mental fashion at any dialectical level. For government must have reference to a society in which there is understanding, but not necessarily by the constituents of the society. Thus any reference of biologists to Dialectical Materialism, such as Needham makes, is correct in one sense, according to present theory, but incorrect in another. He says (*Order and Life*, page 45), "that biological order is a form of order different from those found in physics, chemistry, or crystallography, yet not impenetrable by the human mind or ruled by unintelligible spiritual entities. Translated into terms of Marxist philosophy, it is a new dialectical level." Zavadovsky and Colman (*Science at the Cross-roads*, 1931), state: "The true task of scientific research is not the violent identification of the biological and the physical, but the discovery of the qualitatively specific controlling principles which characterise the principal features of every given phenomenon, and the finding of methods of research appropriate to the phenomenon studied. . . . Affirming the unity of the universe and the qualitative multiformity of its expression in different forms of motion of matter, it is necessary to renounce both the simplified reduction of some sciences to others and the sharp demarcation between the physical, biological, and socio-historical sciences." Prenant, also quoted by Needham (*Order and Life*, page 46), states that "Dialectical Materialism is as much opposed to vitalism as to old-fashioned mechanistic materialism, because both are metaphysical theories. It refuses to trace any sharp demarcation between physics and biology, reserving to the former causal determination and appealing in the latter to teleology. But it does not believe, on the other hand, that biology has the task of reducing itself wholly and effectively to physics. The unity of the universe expresses itself in qualitatively different forms, the characters proper to which must not be lost sight of."

Biologists, such as Needham, Prenant, and Zavadovsky, must, on our hypothesis, be considered correct up to a point in making clear that the organising relations of biology are different from

those of physics, or chemistry, or colloid science. For although all these relations, which are those of science, must finally be related to the three scientific factors of electricity, magnetism, and mesonism, and are therefore qualitatively the same, yet they are quantitatively different. The intra-atomic organising-relations of atomic physics are 'stronger' and more 'binding' than the organising relations of inter-atomic affinity and valency of chemistry which in turn are more 'rigid' and 'binding' than those intermolecular organising relations of colloidal science, which again are less fluid than the organising relations within the cell, or within the multicellular organism.

Biologists are however incorrect, as was Newton, in so far as they import into science, conceptions of force, energy, power, purpose, teleology, causation, government, or society. Scientists should be content with the correct position as defined by the positivists in limiting the aim of science *qua* science to that of description without any attempt to relate cause and effect except in the phenomenalist manner. The appearance of cause and effect in the scientific world is only appearance, is mere regular chronological sequence. The relationship of effect to cause must be left to a more comprehensive viewpoint, that of psychology, according to our hypothesis. The terms 'stronger','binding' and 'rigid', applied in the previous paragraph to scientific factorial relationships, may give a false impression. There is no power in scientific factors.

Population Growth

Growth, or the multiplication of self-propagating particles, has sometimes been regarded as one of the 'real' differences between living and lifeless events. This cannot be maintained in the light of our knowledge of *autocatalysis*, in which comparatively simple chemical molecules, typically non-living particles, grow in number during the chemical processes, which they severally accelerate or catalyse. Moreover, the rate of growth in a closed system, of an autocatalyst, may be represented by the same kind of curve (Figure 6), which is found to represent also the rate of growth in closed systems of virus particles, of bacteria

(*cf.* Grainger, *Nature*, 1940, *146*, 539), and of unit cells, whether these go to form a colony of independent cells (yeast), or to form a single multicellular individual, either plant (pumpkin) or animal (rat). (Raymond Pearl, *The Biology of Population Growth*, 1926). This kind of curve represents also the observed rate of multiplication generally of insects (*e.g.*, the fruit fly, *Drosophila melanogaster*) and animals, including man. In short, the type of curve representing the rate of growth of the population of the same species in any 'closed' system, is the same whether the species be living or lifeless. It will be inferred that all such species may be designated autocatalysts and from this evidence man can be looked upon as an autocatalyst, catalysing change in the system, the biosphere of the Earth, in which he is situated. In all autocatalytic systems a state of dynamic equilibrium is finally approached when the rate of reproduction equals the rate of disappearance of the autocatalyst.

The growth of population of an autocatalyst in a closed system

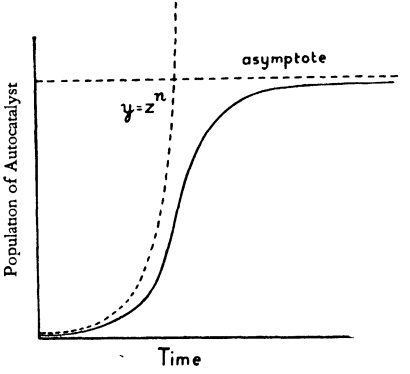


Figure 6

The continuous line represents the normal growth of population in a closed system. The broken line represents population-growth, given complete elimination of enemies (including by-products) and ample food supplies.

In order to throw light on the nature of the equilibrium system or systems of the terrestial society which we can suppose to be autocatalysed by man, we will consider a typical example of chemical autocatalysis. The ester, ethyl acetate, (EtOAc) usually contains a small proportion of hydrogen acetate or acetic acid (HOAc.). When it contains a very small proportion then the rate of ester reaction with water (hydrolysis) is low. This is because the acetic acid is the catalyst for this change. As a result of the hydrolysis, however, more acetic acid is produced as shown by the chemical equation:

$$\text{EtOAc} + \text{H.OH} \overset{\text{HOAc}}{\rightleftharpoons} \text{EtOH} + \text{HOAc.}$$

Thus, given ample supplies of ester and water, if the ethyl alcohol, EtOH, were continuously removed from the system, then the production of acetic acid should theoretically increase exponentially and its concentration should change according to a curve similar to the broken line curve in Figure 6. Practically, however, in a 'closed' system, where there is no such removal, a maximum stationary population density or concentration of acetic acid molecules is eventually obtained. Then the system is in a state of dynamic equilibrium. That is to say as many acetic acid (autocatalyst) molecules are formed (born) in the same period of time, as are dispersed (die).

If then we adjudge that living organisms are qualitatively the same as lifeless species of individuals such as acetic acid, as we do here, it must follow that the growth of population is not a function of the species only but of the whole system within which it is reproduced. The viewpoint, that growth is a function of the species only, cannot be upheld with any certainty because of the considerations which we have here presented.

New species have arisen, and will arise because of the further influence of the nebular, photon (and cosmon) wave-changes on the species already existing. That is to say that no 'closed' system eventually producing a large population of one species can ever be entirely 'closed'. The impalpable universal nebular, photon (and cosmon) processes continually influence all such systems

and therefore help to produce new species of auto-catalysts from those already present. This view that the continually changing universal wave-processes are responsible for the possibility of novelty, the origin of new species, for *variation* and *mutation*, and for the evolutionary process generally, has already been outlined. It seems that malignant or cancerous growths are due to the operation of cosmon and photon processes, and especially the latter, when they persist at above a given intensity either within or on a person. This view also supplies *the reason for the non-formation of living from lifeless species to-day*—the system of the earth has altered since the time when living organisms may be supposed to have been spontaneously generated from non-living individuals. However, the success of chemical synthetic methods holds out the hope of the eventual possibility of man being able successfully to discover and to indicate the required conditions and so synthesise the 'living' from the 'non-living'.

Let us now consider further the nature of an autocatalyst. And first we will consider the nature of a catalyst. A catalyst may be defined as a species of event, in which localisations of one or the other kind of will or a separation of the two kinds in an event, represented in science either as localisations of positive and negative electricity (ions) or of electrical dipoles respectively, tend to induce local intensification of will of the opposite kind in neighbouring events, of species other than the catalyst. This localisation of will, induced by the catalyst, produces increased (or decreased) activity of the neighbouring events. Thus the equilibrium, which would presumably be reached eventually even without the catalyst, is reached more quickly (slowly) with it present. A catalyst influences other species through its will and through its person generally inducing and emphasising (or diminishing) certain inherent desires, thoughts, and emotions, in the other species. A catalyst may thus alter, that is accelerate or retard, the rate of change within a society. From the viewpoint of autocatalysts, with which we are immediately concerned, we have only to deal with acceleration of change and not with retardation.

An *autocatalyst* is a species of person accelerating change within a society of real persons, and, as a result of this change, multiplying so that the population of that species within the society increases according to a typical curve (Figure 6). We may say that an autocatalyst like any other catalyst stimulates inherent desires and activities in the society in which it is a catalyst. Part of the society may be regarded as its 'food'. Thus in the system involving ester hydrolysis and ester formation, mentioned previously, the autocatalyst, acetic acid (not "acetic acid"), may be supposed to stand before its 'food', ethylacetate and water (not "ethyl acetate" and "water"), and so to stimulate them that they are more quickly changed and incidentally produce more acetic acid. Although with such a simple system it is difficult to decide whether 'pure' ester and 'pure' water would ever give rise to alcohol and acid, yet when we consider the fly *Drosophila* and its food, banana-agar, it would appear that the latter, without the fly, would never produce the fly. That is to say, the food without the autocatalyst would never produce the latter. From this it would be easy but possibly false to infer that 'pure' ester and 'pure' water would never give rise to alcohol and acid, in other words that an autocatalyst may *initiate* the change in the system and thereby ensure its own multiplication. It seems more likely from all the evidence, however, that in the ester hydrolysis system a slow change without catalyst may occur.

It is of interest to recognise that an event can only act as an autocatalyst in a system containing other species which are so allied to itself that it may be produced from them. For example either the acetyl (Ac) *or* the acetate group (OAc) of the autocatalyst, acetic acid (HOAc), is contained in the species of ester, ethyl acetate (EtOAc); and either the hydrogen (H) *or* the hydroxyl group (OH), of the autocatalyst acetic acid, is contained in the species, water (HOH). 'Assimilation' actually must follow from this condition of the autocatalytic system and not from any mysterious transmutation of 'food' into flesh and blood. The other 'end product' of the autocatalytic system, namely, ethyl alcohol in the ester-hydrolysis system, would normally be

regarded as a by-product arising from the process of 'excretion'. This kind of process always accompanies the process of 'assimilation' during autocatalysis, that is, during the multiplication of self-duplicating particles or persons, and also during the growth and self-maintenance of living organisms or persons.

Although the concentration of a normal catalyst or enzyme—an enzyme being an organic catalyst—is generally assumed by chemists to be negligibly small compared with the concentration of the substances or persons which it influences, yet it appears that the concentration of an autocatalyst, depending on the position of the equilibrium of the particular system in which the autocatalyst multiplies, may finally be comparable to that of the 'food'. In any society the maximum actual population density, or concentration of the multiplying organisms, will be determined partially by the concentration of the food available, where food for 'living' organisms usually includes air and water, and partially by the concentration of the by-products. The value of the upper asymptote of the curve will be thereby determined.

We have, as yet, paid no attention to the influence of *enemies* on the multiplication of a living organism. Enemies are other species of persons, who may compete with the one species in which we are primarily interested, for the 'food' (indirect enemies), or may destroy the species, in which we are interested, by direct action (direct enemies). Persons within the same species may also be mutual enemies, indirect or direct, but we are concerned for the present with enmity between different species. In the hydrolysis of ethyl acetate, anhydrous sodium sulphate if added to the original system, would be an indirect enemy of acetic acid, because it would remove some of the water present, and so, by diminishing the food concentration, would diminish not only the rate of multiplication or propagation of acetic acid, but also its final concentration. Sodium hydroxide would be a direct enemy because it would destroy the autocatalyst acetic acid itself, to give sodium and acetate ions, ("ions" are electrically charged "atoms" or parts of "molecules").

Further consideration must be given to the effect of the by-products, which can be regarded as enemies of a special kind, arising out of the process of assimilation of food, that is, from the process of propagation of living organisms. If the by-products are wholly removed in some way from the whole system, so that they no longer react with the living organism, (autocatalyst), there will be no equilibrium position due to this reaction. It is probably true to say that they are never completely voided from the organism, carbon dioxide always remaining at some concentration. Therefore there will be an equilibrium position of growth, on this account. If however, there were complete removal, there would still be an equilibrium position but this would be wholly dependent on the relative proportions of food, and enemies other than by-products.

The present notion of population would generally agree with the Malthusian and Darwinian conception of "the tendency of all organisms to increase in a geometrical ratio" (Huxley, *Evolution,* 1944, page 14). Yet this increase must more correctly be taken to correspond to the initial part of the typical curve for population increase. This would *appear* to give an increase of geometrical ratio type. Only with ample food and space and no enemies, including the complete removal of by-products, could the appearance actually be realised, for only then would there be no upper limit for the population of any one species of autocatalyst, and the curve of population growth would correspond to the exponential equation, $y = z^n$. Here y would represent the population after n generations, and z the average number of progeny, in each generation, from one parent,—the so-called geometrical ratio of Malthus.

One difference between living and non-living autocatalysts is that the former can at least partially void their by-products, but that the latter normally cannot. This difference can only be explained on the basis of the formation of a 'surface' for a living autocatalyst; a surface being an interface between the living organism and its food and by-products, whereas there is normally no such interface for non-living autocatalysts, such as acetic acid

in the ester-hydrolysis system. Even this difference, between living and non-living autocatalysts, can only be quantitative and not qualitative, because even man never completely eliminates his by-products (not "by-products") which are events of mind and spirit, but being his enemies, are repugnant to him. We are here regarding man as an autocatalyst in the reaction which may be represented as :—

$$\text{Compounds containing elements such as nitrogen, phosphorus, calcium, iron, carbon, hydrogen, oxygen, etc.} + \text{Air} \overset{\text{man}}{\rightleftharpoons} \text{man} + \left\{ \begin{array}{l} \text{hydrogen oxide, (water)} \\ \text{carbon dioxide,} \\ \text{urea, and} \\ \text{other compounds} \end{array} \right\} \text{by-products}$$

This equation is an extremely simplified version of what are known to be very complicated processes, represented very partially and inadequately by the yeast and muscle, lactic and alcoholic fermentation processes, involving carbohydrates (*cf.*, The Embden—Meyerhof schemes. *Annual Reports of the Chemical Society*, 1934, page 334, and later Reports). However, it may be seen that the limitation of growth of the community of unicellular organisms which is man, will be partially due to the incomplete elimination of by-products from the autocatalytic society. Another very important difference, between human and non-human autocatalysts, is that the former may disturb the equilibrium by conscious and complex control of the society. For example, man may devise methods of increasing his food supply and of destroying his enemies. Therefore the equilibrium position of the human population of the earth may conceivably be altered out of all recognition. He may also eventually colonise suitable heavenly bodies throughout our Galaxy. Under any circumstances, it would appear that a position of equilibrium will always eventually be attained whatever the food supply may be, due ultimately to competition between man and his environmnet, including other men.

Equilibria, including autocatalytic equilibria, are systems or

events. The universe, although not an event, is one vast equilibrium. Our discussion reveals that equilibria exemplify *dialectic:*

$$\text{thesis} \rightleftharpoons \text{antithesis}$$
$$\text{synthesis}$$

But this is psychic or Hegelian and not materialistic or Marxist. Dialectical Materialism has no basis in the reality of the universe but reflects only the sensual appearance of this reality.

The Organisation of Carbon Compounds: Optical Activity

Although qualitatively the organisation exhibited by all persons, inorganic and organic, living and lifeless, is the same, yet the conventional difference between the living and the lifeless is useful. It is useful because these terms point to quantitative difference of organisation, which, when sufficiently large, gives the appearance of qualitative difference. The difference rests on the apparently unique properties of the carbon atom as contrasted with those of other chemical atoms. Although I use the term 'unique' the qualities of carbon are only quantitatively different from those of other atoms. That quality of carbon, by which stable links may be formed between many carbon atoms, giving structures which may therefore adopt many different conformations, including what are called straight-chain and cyclic structures, is shared in smaller measure by other chemical elements such as silicon, tin, and boron. Its property of uniting with almost equal facility with hydrogen and oxygen or with other elements such as nitrogen, sulphur, and phosphorus, so as to give molecules having dipoles, is likewise shared equally with other atoms. However, because of the first mentioned property of carbon, the dipoles may be separated more in carbon-compounds than in the compounds of other elements, so that we have here a possibility of distinction between the two ends of a well-organised person. We have, in other words, the possibility of differentiation between the head and the tail of an event which arises when we reach the biological organisms. This is important because the effective polarisation of will (electricity) enables organic molecules and living organisms to be autocatalysts *in excelsis.*

The property of *stereoisomerism,* whereby it is possible for the same carbon structure to possess several different configurations, and to display *optical activity,* is shared with compounds of other elements. Carbon compounds show stereoisomerism however, in the highest degree, because of the first-mentioned property of the carbon atom. These properties of compounds of carbon provide the basis of the organisation, typical of biological organisms. *The optical activity shown by quartz* and other inorganic crystal organisations is of another kind, being due not to the configuration of atoms within a molecule, but to the configuration of molecules within a crystal. Both these kinds of optical activity can, however, be related at bottom to the left-hand and right-hand helix curve properties of the electron and positron and of 'negative' and 'positive' photons. The two kinds of oppositely circularly polarised light-photons of natural light would, if of the same short-wave (S) period, when in close proximity, become associated in pairs through their opposite polarities. They would then constitute plane-polarised light. Being 'enantiomorphs' they would have different velocities (v_L) in an optically active medium (and would thus be separable as Fresnel demonstrated), the plane of vibration rotating uniformly as the light passes through the medium.

Of all the classes of carbon molecules, that which is most typical of living events is the protein molecule. The structure or better (since structure is a spatial and therefore a static abstraction of what is a dynamic space-time event—an undulatory process) the organisation of the protein molecule, is not clearly known since no protein has been synthesised. However, it is thought to be formed from units which are amino-acids. Although all proteins are very similar in many ways yet they constitute a very large class of events. According to Professor Stacey (*Proteins and Life,* 1947, page 4), "so individual are the proteins that it has been said that shortly the proteins of a man's blood may be used to identify him from all others as rigorously as do his finger-prints." Proteins constitute a large proportion of man, being found in his skin, bone and cartilage, teeth, muscle, brain and

nervous tissue, liver, heart, lungs, spleen, kidneys, pancreas, and alimentary tract. Many hormones, or chemical messengers, in living organisms are proteins.

The proteins of the biological 'cell' are continually undergoing an exchange of amino groups and thus the proteins must themselves continually suffer breakdown. The amino-acids so liberated must continually be "replaced by identical amino acids coming from sources outside the cell. Thus the older concept that the proteins of the cell are stable entities must be abandoned, for, though their gross nature may remain unchanged, their constituent parts are in a continual state of flux." (Stacey, *ibid.*, page 127). This is merely another instance of flux within the permanence of events, since it is true also of all liquid systems, whether of the dynamic equilibria of ordinary chemical systems containing different species of molecules, such as for example, water and ethyl acetate, or where only one species such as for example pure water is concerned. Once more there is to be perceived continuity of the mode of organisation from comparatively simple molecules such as water to the most complex protein molecules. This continuity can be carried down to the level of the atom, where electrons may be lost and gained continually, by one atom in a community of atoms, and up to the level of man, where flux within permanence is well known as has been related.

Biologists' views on the general aims of science

It is a convenient opportunity here to reply to Dr. Needham's view on the general aims of science. We cannot agree with him (*Order and Life*, page 12), in his statement, which coincides with the views of Tenant (*Philosophical Theology*, 1928–30, Chapter III), that "the alogical core of the world is not a residuum of haze which science, when ideally perfect, shall have dissipated; it is, on the contrary, a determinateness, occult, inexplicable, and rationally incomprehensible." We cannot agree that there is an 'alogical core' of the universe. For us the universe is a system of universal logic (p. 197). The proper wave-system or person of the universe is not transcendental and therefore

inexplicable or alogical for any constituent such as man. Although this system constitutes the law imposed yet man can theoretically understand it. This would follow because the law imposed is supposed to be constituted entirely of the law immanent, in man and other constituents of the universe, and only of this law. Nevertheless, according to our hypothesis he can never accomplish this by way of science alone, but only through the translation of the results of scientific investigation into terms of psychology, as we have outlined.

The Mystical Theory of Light

We shall now examine very briefly the relationship between our hypothesis and the ancient eastern theory of Light. The two theories are closely related, since according to the latter, light is the fountain and origin of all things. There are two main differences. The first is that according to our hypothesis, the major 'straight' and 'curved' events of the universe contain as nuclear wavelets, cosmons, photons, and electrons (positrons), these particles being different phases of the same particle, so that cosmons, electrons, and positrons, are at least co-equally fundamental with photons for the generation of all persons within nebulæ. The second reason is that "light" experienced by man as radiance, is not light as it is thought to be in essence according to our hypothesis, whereas, according to the eastern theory, light was presumably supposed to be as experienced by man. The two are nevertheless similar in attributing to light a fundamental place in the production of all creatures in the universe.

CHAPTER VII

THE INDIVIDUAL, THE COMMUNITY AND SOCIETY

The theory of biological field and the Gestalt Principle

The modern biological ideas of 'organiser' and 'field' are fairly readily interpreted by way of the hypothesis. The *organiser* can be regarded as an individual who is a catalyst and acts, (as has been described in the previous chapter) by inducing or facilitating changes in the system containing it. The theory of *biological field* was introduced by Gurwitsch, and has been defined by Waddington (*Science Progress*, 29, (1934) 336): "A field is a system of order such that the position taken up by unstable entities in one portion of the system bears a definite relation to the position taken up by unstable entities in other portions. It is, in fact, their equilibrium which together constitute the field effect. This is in close analogy with the equilibrium reached by a particle of iron as it orients itself in a line of force of a magnet. Field laws, therefore, are simply a description of how stable configurations are reached in development; the further problem of why these and no other configurations are stable, lies beyond. But against any who wish to urge that the individuation-field is only yet another fig-leaf for our ignorance, it should be said that a dynamic description of the events is an enormous improvement upon the static description of anatomy. This, too, is the answer to the question whether a field should be regarded as active or passive; it is a dynamic description of a spatio-temporal activity, not a mere geometrical picture of a momentary time-slice in the organism's history."

This picture of the biological or individuation field is wholly in keeping with the dynamic but apparently static fields of the persons portrayed by our hypothesis (Appendix III). The

differentiation-rate of the parts of a person, which is to say of organisation within the unity of the body and fields of the person is roughly related to the growth-rate of the person (Murray). Even the production of one relatively simply differentiated individual (molecule) of acetic acid takes time, as does the production of a human individual. Both the lifeless autocatalyst, acetic acid, and the living autocatalyst, man, may be regarded as organisers of a peculiarly comprehensive kind, being capable of influencing the organisation of complete persons and not just constituent organs; limbs, eyes, etc., like the usual kinds of biological organisers. All organisers, however, exercise their influence, that of their persons, on the society within which they exist. In the instances of man and acetic acid their influence is exercised so as to facilitate the multiplication of their respective species. The difference between them is quantitative and not qualitative; it is due to the relative simplicity of organisation or differentiation of the parts of hydrogen acetate as contrasted with the relative complexity of the organisation of man. In both instances, however, the 'food' from which the autocatalyst is to be synthesised, must be present within the equilibrium system or society referred to, and of which the autocatalyst is a constituent. This food is always modified within the wave-system of the individual autocatalyst.

This interpretation of the action of organisers and fields may be regarded as ineffective because it tends to neglect the problem of the morphogenesis of one individual. The acetic acid molecule or individual is formed as acetic acid and, apart from phase changes which occur (according to the hypothesis) during the life-period, by and large remains as acetic acid so long as it exists. Its growth during autocatalysis, however, although mainly due to an increase in the number of individuals of the same species, is also determined in part by the rate of formation and thus of organisation (morphogenesis) of any one such individual. Man is initially a single cell, but grows into a differentiated and organised community of many millions of cells of very different behaviour patterns. We can therefore distinguish between the

population growth of a community of men or of a community composed of individuals of a simple autocatalyst such as acetic acid and the population growth of the cells of a single multicellular person during his development. Although this distinction is made it is only quantitative and not qualitative. As has been reiterated again and again by modern biologists (*cf.* Waddington), form has no significance except as function. Form is the geometrical and spatial abstraction of what is active organisation and vibratory process. Let us not then be misled by the term morphogenesis into thinking in terms of static form. We must think in terms of undulatory process, the activity or behaviour of the organ or part, and not merely of its form.

Communities of living organisms of the same species which are not bodily conjoined are known. These, although undoubtedly consisting of individuals of the same species, yet consist of different individuals having different patterns of behaviour. One illustration is that of a community of bees. The full development of a bee embryo into queen, worker, or drone (male), depends partially on the food provided for it, that is to say on the system in which it exists. Here we have organisation or differentiation of the parts of a community depending on the environment or society within which each constituent part or organ finds itself. The differentiation of behaviour in this instance is akin to the differentiation of behaviour of the different organs or parts of a community of cells which are bodily conjoined. This is paralleled by the differentiation (dissociation) of personality induced by different environment giving the 'multiple selves' of any one man (page 63). There is no fundamental and qualitative distinction between the kinds of organisation in these types of community.

This is a clue to the problem of morphogenesis of a bodily conjoined community of cells. The different behaviour patterns of the various cells of the same species, will likewise be evoked by the different environments or societies in which they severally have been placed. Organisers have no doubt a part to play in this conditioning of cells, but the general environment or society

must be suitable for normal development. It will then be the whole society, as it affects a particular part, which will influence the development and growth of that part. This is analogous to *the Gestalt Theory*, a Gestalt being defined as a "system whose parts are dynamically connected in such a way that a change of one part results in a change of all other parts" and *vice versa.* (K. Lewin, *Principles of Topological Psychology*, page 218). In the bee community it is not mainly a field effect but the active bodily agency of individual mature bees which influences the development of the embryo bees. Similarly the organiser or hormone generated in one organ or part of a developing creature moves bodily to another part—the appropriate part—to help to effect the normal development of this part. That the biological field plays a part in morphogenesis is undoubted on the present hypothesis, but so does the organiser. There still remains the question as to how and why the germ cell of a particular species generally develops in a specific manner to give a mature individual of that species.

Professor McDougall for example (*The Riddle of Life*, page 227), refers to this question of heredity in determining the organisation or morphogenesis of a community. He says "it may be admitted that the scheme of social differentiation and adaptation in the community of similar cells which is the embryo, after the fashion of a social organism, would produce a differentiated organism *of some kind.* But why an organism precisely true to the pattern of the species in a vast multitude of features, both large and small?" The answer to this question on the basis of our hypothesis is that the racial memory (or instinct), purpose, and intelligence, which appear to be required for this to happen, would be those of the universe, or at least of the portion of the universe, which is the embryo. The universe, being immortal and being fundamentally psychic, will possess the requisite memory, purpose, and intelligence.

The difficulty in recognising the similarity of the nature of the two kinds of community, one bodily conjoined and the other field conjoined, is the same as the difficulty that one has in

realising that all persons must be regarded not as truly free persons, but as being modified within the only completely free person, namely the universe. In other words, it is impossible for me to move off into cosmic or internebular space freely, or into cosmic time. My substantial space-time (*i.e.*, myself) is largely determined for me. The individual cells within a multicellular organism are obviously modified and are therefore rightly regarded as parts of the organism. The individual bee within a community of bees is not so easily recognised as being modified. Nevertheless any bee is rightly regarded as a part of the organism which is the bee community. The same is true of all communities and the organism is closely knit, rigid, diffuse, or flexible, depending on the degree and kind of union effected between the parts. In a community, where there is little or no bodily (but only field) conjunction of the parts, they are usually termed individuals or persons. Where there is bodily conjunction of the parts, they are usually termed parts or, with living organisms, are termed organs. In the field-conjoined community the weak direct forces of union through the fields of the parts, are often supplemented by the indirect forces of union (sympathy) aroused between the individual parts or members by language, language being recognisable and significant behaviour patterns. This presupposes that the individual members of such communities are events which can know, which would agree with our main thesis that all events are events of knowing.

Distinction between Society and Community

As contrasted with a *community* in which modified individuals composing the community are of the same species, a *society* is any system of parts or modified individuals which are not all of the same species. In this sense a molecule such as water, or indeed any atom, is a society. Autocatalytic systems are autocatalytic societies. Included here are the societies embracing living organisms as autocatalysts, where the equilibria may eventually become very complicated.

The primary germ cell of man is an autocatalyst in a society

of many different species within the mother's womb and gives rise to the community which is the well-organised baby at birth. The mature man is also an autocatalyst in a society of many different species within the biosphere of the earth, giving rise to the community of humanity as a whole on the earth.

'Life' and the flexibility of organisation of a community.

The differentiation of the parts of an organism or community is a measure of the natural flexibility within the community, and of the vitality of an organism. Rigidity of organisation means 'death'. Thus a plant community has naturally a relatively rigid organisation compared with any animal community and is less alive. Viewed in this way a crystal such as a diamond composed wholly of carbon has still more rigid organisation and is therefore still less alive. Its greater rigidity of organisation is related to the lack of differentiation of the organs or the parts, as compared with any plant or animal organism. Thus rigidity of organisation or lack of freedom of the parts within the organism increases, the smaller the differentiation between the parts.

In assessing the characteristics of an organisation, let us consider the organism man as a single community. His organs are bodily conjoined for the most part, although the blood flows through arteries, heart, and veins, and the phagocytes are mobile. Thus it would appear that the factor of relative mobility of the parts within the organism is small and on this count the organisation of man would appear to be rigid. However, there is great differentiation in function or behaviour of the parts within the organism and on this count the organisation of man is regarded as highly flexible and man as very much alive.

Water molecules in different geographical localities of the ocean are incapable of wide variation of behaviour, as also are molecules of oxygen or nitrogen in different parts of the atmosphere. Yet these simple molecules do move fairly freely relatively to each other within communities of their own kind. In these communities the individuals are field-conjoined. Relative movement of individuals within a community is, then, not necessarily

a sign of flexibility or vitality of organisation, but may be a sign that the individuals are field- and not bodily-conjoined. Life and vitality within a community is seen to be due not to relative mobility of the individual parts, but to different patterns of movement, or variation in the patterns of behaviour, of the different individual parts or organs. This would hold good also in psychology and the capacity of forming a multiplicity of selves—dissociation within integration—would be a sign of strength and not of weakness in man. The idiot and the 'single-selfed' lunatic are less consciously alive than the ordinary man.

The organisation of a community

Because any multicellular organism is a community, the considerable scientific knowledge of this kind of organisation should prove to be of great assistance, in helping us to attain to a knowledge of what is necessary, for the life and healthy organisation of any community, and more especially, a community of men.

Before we commence to discuss this topic, however, we must elucidate the nature of the binding forces of all communities, whether, as we have previously labelled them, they are bodily or field-conjoined. By the former has been implied a community such as one man, and by the latter a community such as that of many men. In the former the degree of union is high as denoted by the term 'bodily-conjoined' and must involve the near-body or more intense fields of the organs or members composing the community. The union is not usually through the more vital organs, that is those organs which display marked variation of behaviour from each other, such as the liver, kidneys, skeleton, stomach, heart, lungs, and brain, of man, but through connective tissue or skin which is relatively undifferentiated in its behaviour throughout the organism, but is itself an important organ whether outside or inside the organism. In the latter the degree of union is low, as denoted by the term 'field-conjoined', and must involve the outer and less intense fields of the individuals composing the community.

According to our hypothesis union between individuals in

either kind of community takes place through the essential factors of will, intellect, and feeling, and not, as is usually thought through the scientific factors of electricity, magnetism, and gravitation. The latter factors are merely powerless representations in the minds of observers of the former factors. The right appreciation of this fundamental principle of the hypothesis is very necessary for the understanding of the existence and behaviour of either kind of community, but more especially of the manner in which the second type, the 'field-conjoined' type, of community may come into existence and may develop. For although, through the work of scientists, we may fairly readily describe the behaviour patterns of a bodily conjoined organism in the scientific terms of electricity, magnetism, and mesonism, where these factors are 'considerable' and therefore fairly readily discernible and measurable, yet, where these factors are inconsiderable and therefore scarcely discernible, as with field-conjoined communities, then the work of scientists can only help us through observations of gravitational fields and indirectly by analogy. Through the use of our hypothesis, scientific evidence may be indirectly of great help.

Any community can only continue to exist where the members composing it have merged their individualities to some limited extent in the community. This merging takes the form of a limited fusion of the wills, intellects, and feelings, of all individuals within the community. This implies a similar constitution and outlook, which we may call sympathy between individuals, before they can form and maintain a community, but it does not imply complete sameness of the individuals. Indeed complete sameness of the individuals would spell antipathy. This may be taken to be denoted by the *Pauli Principle*, concerning the union of atoms. According to this principle no two atoms which are exactly alike can unite directly in helping to form those communities or societies called molecules. The necessity for difference to promote union is shown fundamentally by the two different kinds of polarity, represented scientifically by positive and negative electricity. This necessity is also demonstrated by the difference

of sex. Sex difference, like all other differences, are here taken to be illustrations of polar differences of will, in association with feeling and intellect, so that, like all other persons, even the electron and the positron, as well as the photon, may be regarded as having sex. Behaviour (function and form) would thus be intimately and fundamentally bound up with 'sex' and there would here be strong support for this aspect of *Freudian psychological theory*. Sympathy is the outlook partly, but not wholly, inspired by such differences. Much of the sympathy between individuals is due to sameness. For example, mating generally occurs between persons of the same or closely allied species and, more often than not, between persons of the same variety, within the species.

We may now ask whether the order and organisation of any community should be 'collective' or 'hierarchical'. By hierarchical organisation is here meant organisation comparable to that of an army where order is maintained through different ranks of individuals (here of the same species), the higher ranks issuing instructions or commands to the successively lower ranks, for the guidance of their conduct. The behaviour patterns of a community thus organised are finally controlled by the topmost rank of individuals or individual. Where one individual alone is in the topmost rank we have, in a human community, a dictator. A modern king has lost his erstwhile dictatorial powers. Where more than one individual is in the topmost rank we have a community council or government, the human personnel of which may change but the council persists. As in any army, so in a hierarchy, the control of the central government, dictator or council, over the behaviour patterns of the very numerous individuals of the lowest rank, is remote. Immediate control of these individuals is usually effected by those of the rank one grade higher, and this is true generally for the successively higher ranks.

By collective organisation is here meant organisation in which all members have merged part of their individualities, but there are no higher and lower ranks, no hierarchy as between individuals of the same species. All individuals, assumed to be of the

same species, are of the same rank although they may and do behave differently one from another. However, because the community itself, as a different species of individual, imposes control on its parts and is of a higher rank, the organisation is so far centralised and hierarchical. *In this way, only, may the collective organisation of a community also be hierarchical.* We shall term such organisation '*collective*'. In numerically simple communities it might happen that all members would be united co-equally with all other members, but generally it is supposed that any individual would be associated more closely with his near neighbour and less closely with those more distant. With this kind of organisation there would then be, not necessarily a classless, but a rankless community. This would be in contrast with a hierarchical community in which there would be several ranks, individuals of the lowest rank being most constrained in their behaviour, the degree of constraint decreasing successively for the successively higher ranks, and the members of the highest rank or government being almost, but not entirely, free from constraint within or by the community. The constraint here would be that of the governors behaving as they must, to maintain the hierarchical community.

Outside the constraint put upon their behaviour by their being members of a community, whatever the nature of the organisation hierarchical or collective, and also outside the constraint put upon their behaviour by their nature as individuals of a certain species, individuals of the same species within a community may conceivably behave differently one from another. Where the pattern of such behaviour is approximately similar for several individuals, then they may be said to form a class of individuals within the community. Thus we may have different classes of individual within the ranks of a hierarchical community or within a collective community.

The Organisation of Human Communities

What is the evidence of science regarding community organisation which may give us the clue to the kind of organisation that

ought to hold good for human communities? In brief, it is that collective organisation always operates. We will examine this by reference to the organisation of the nucleus of an atom, of the molecule of an element, of the diamond, of a drop of liquid, and of the living organism, man himself.

The organisation of *the nucleus of an atom*, at least where the atomic weight is high, is comparable to that of *a drop of liquid.* The nuclear particles or nucleons, members of the atomic nucleus or nuclear community like the molecules within a drop of liquid or member of the liquid community, are mutually united, largely with adjacent members of the community, yet each member is also united to some extent with all the others. All the individual members of these two types of organism are approximately equally united or constrained in behaviour and the organisation is collective, not hierarchical, for the members. Nevertheless, there is hierarchical control, by the nucleus, or by the drop of liquid, of its constituents. In *simple molecules*, such as those of the chemical elements, hydrogen, oxygen, nitrogen, each of which molecules contains two atoms, both these members, of each small community of two, are co-equally united and neither dominates the other. There is, in this simple way, collective organisation of the community. In the giant molecules or *crystals of carbon, either diamond or graphite,* the atoms of carbon, although united mainly to adjacent atoms, must be supposed to be united also to all other atoms of carbon within the unity of the molecule. Here again the organisation of the community is collective. This kind of organisation is comparable to that of a metallic crystal, where the electrons of the 'electron gas' are not bound to a definite atom, but to every atom in the crystal lattice of the metal, and the binding or internal potential is a space-periodic- or wave-function, of a type capable of expression by Schroedinger's wave equation. This may be regarded as related to the proper wave-system of the crystal community.

In *the living organism of man* the organs, all composed of cells of the same species, occupy fairly well defined positions like the atoms of carbon in the diamond. And as with the latter, where

the carbon atoms are co-equal in the community, so it appears that man's organs are approximately co-equal in the community of man, for the brain does not *directly* govern the heart nor the heart the brain, neither does the liver directly control the stomach, nor the stomach the liver, and so it is with other organs, although they may indirectly affect each other. Once again the individuals or organs composing the organism appear to be co-equal. It is true that organs which are adjacent may affect or control or constrain each other more than those which are further apart, as for example the pancreas and the small intestine, more than the pancreas and the brain. But this is true also, if not exactly in the same way, of adjacent carbon atoms in a diamond. The organism of man then might appear to be of the collective type with no central government located, as is sometimes supposed, in the brain and the central nervous system, but with strong local government in all the organs contributing to the vitality and strength of the collective organisation of the whole man. This must be discussed in more detail especially with reference to those organs, the brain and the central nervous system, which appear to give rise to consciousness and self-consciousness in man. For otherwise it could be objected with good reason that too much has been made, in the present argument, of the organs at the unconscious level and not enough of man's pre-eminently distinctive organs mentioned above.

It may be objected for instance that the brain and central nervous system of man can and do control the organs of speech and the muscular skeletal organs, particularly during the process of habit formation. The question remains as to whether in fact this is so. If it were so, then it would have to be conceded that here is an instance of community hierarchical organisation, of members by members, with all the implications which would follow, on our argument, for the organisation of human communities.

It is contended that it is not so, because the whole state or condition of the human organism affects the possibility of effective conscious action, or even the possibility of conscious action.

The effects of anæsthetics and narcotics are evidence of this. It is therefore not only the brain, but the whole person who is responsible for co-ordinated conscious behaviour during muscular activity and habit formation. In other words the only hierarchical control is that of the proper wave-system—the whole ego—over its members, although the brain must be mainly responsible for 'consciousness', since that may be taken to be its function, in the same way that the heart's function is to circulate the blood throughout the organism, This interpretation is in agreement with Dr. G. E. Coghill's theory of differentiation or individuation, according to which, local limb reflex actions occur after, and are derived from, the reaction of the whole organism to its environment. To quote: "Organ systems must be secondarily attained by a process of individuation within a totally integrated system, and the development of the behaviour patterns must be effected, not by an integration of independent reflexes, as is usually considered, but by a process of individuation within a total organismic system, which is from the beginning of reaction integrated as a whole. The basic principle, therefore, in the development of the nervous system of vertebrates, appears to be *the maintenance of the integrity of the individual while independencies are growing up within it, and are, so to speak, struggling for ascendancy among themselves and for dominance over the individual.*" As applied to the organisation of human personality he says: "The higher and more complicated expression of this conflict concerns the integrity of personality. Here it is chiefly the cerebral cortex that is the seat of the conflict between the partial and total patterns of integration. The various components of the personality, according to this hypothesis, just as local spinal reflexes, develop by individuation within the - - - - - - - total integration, and their normal function depends upon their subordination to that." (*J. Genet. Psychol.*, 1936, *48*, page 19).

Even the heart cannot fulfil its responsibility if the organism is not alive, that is to say, if the other organs of the community do not provide it with the right environment. Now this environment, when the heart is situated within the organism, is provided

by the wave-function or government of the whole organism, which is capable of selection of the 'food' required for its maintenance. That a heart can be made to continue beating outside an organism by suitable arrangement of its environment only goes to show the vigour and large measure of autonomy of the local government of this minor community (within the major community, man), when it is given independent status and the right conditions for independence. It is none the less still dependent on its environment, which is then provided by the experimenter. However it may be objected that the environment under these circumstances is provided by no specific wave-system, and that therefore the heart, when within the community of the organism, is not governed by any wave-system such as we have postulated for the whole organism. This objection may be removed by realising that the beating or activity of the heart under these circumstances is not quite the same as when within the organism, since it does not beat more rapidly or more slowly depending on the calls made on it by the organism of which it would normally be a part.

It is in this way that the co-ordinating wave-system of the whole organism may be supposed to include the behaviour pattern or local government wave-system of the heart. The nutriment solution provided by the blood stream in the human organism may then still be taken to be provided to the heart by the co-ordinating wave-system of the whole organism although the reverse seems to be true. Thus although the wave-system of the heart appears to have hierarchical dominion over the blood yet indeed the very nutrients required for the heart-beats are supplied by the blood and eventually by the whole organism. In a similar way although the brain and nervous system appear to control the muscular system, it is considered that their association is reciprocal since intensive muscular activity tends to diminish consciousness. How this occurs is far from clear, but at least it enables one to realise that the interaction of brain and muscular systems is not entirely unidirectional. The union between these two systems can be considered to be comparable

to that between two atoms of carbon in diamond in that both systems are mutually and specifically conjoined within a larger unity. There may thus be an appearance, locally, of hierarchy, but the organisation of members within the community is collective.

As has been said, adjacent members of a community influence each other through their wills, intellects, and feelings, more than members who are more remote. Adjacency, in the sole instance of the human community, has however, acquired a different meaning from the normal, where it has to do with nearness in space and time. With mankind, language, conveyed by telephone or radio, but more especially written language, now permits a stronger influence over men of the present by men of the past, and of men in one locality by men in distant localities, than may obtain for men who would normally have been regarded as adjacent, if human language had not been used in these ways.

Hierarchical organisation partially involves the simultaneous sway or influence of one or a few over many. Although a hormone, or the brain, or any other organ may appear to exercise a limited influence of this kind in the community of cells and organs of one man yet I hope that it will be conceded that all members are co-ordinated within the proper wave-system of the community, and that the members of this community mutually influence one another. Similarly an orator or a statesman not only influences, but also is influenced to a great extent by, the human community of which he is a member. The views which he expresses are on topics of interest to the community. He has no influence outside the co-ordinating system of the community. Hence it is maintained that the organisation of the members of any community is collective although it may appear to contain local elements of hierarchy.

The inference, to be drawn for *the method of organisation of the members of human communities* is plain. It also should be 'collective' and a large measure of freedom of conduct and government should be allowed to local communities. Variations in the conduct of the different local communities should not only

be expected but should be facilitated and encouraged. This would hold true also for all smaller communities within the local communities, and for all individual men according to the principle that without differences of conduct and thought there is no 'life'. Nevertheless, without harmonious co-ordination of these differences there is no healthy life. The latter would involve the imposition of the will of the whole community on the parts and the partial sacrifice of the freedom of action of the parts. Finally then, the organisation of a community would be collective and also "hierarchical" but the latter only in so far as the community itself, as a person of a different species and transcendental to the persons of its parts, would properly control these persons.

Several other points of interest from the viewpoint of *the health of any human community* have arisen from the discussion. First the community should have many differing kinds of societies or environments available for variation in the nurture of the individuals and the smaller communities required for the development of a highly varied and therefore lively community. Secondly, it should know what the many varied diets are, expressed in terms of 'conscious' mind and spirit, that is of human values, so that it may choose those which will promote the health and vitality of the community. Thirdly, it should organise surfaces or organs, of definite and specific mental and spiritual choice, so that the desired kind of food may be absorbed through them into the human community. Other surfaces and organs should also be developed for the ejection of by-products which otherwise, as enemies of the community, would tend to prevent its fullest and most vigorous development, as shown by the population growth curve (page 166).

The Organisation of a Society

A society is a system containing individuals of different species, each of whom is more or less constrained in his behaviour by all of the others, and more especially by those who are adjacent to him in the society. We can say immediately that, as with a community, a society is an organism transcendental to the con-

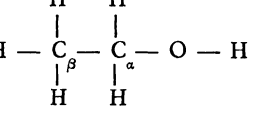
stituent persons and thus properly (but by no means wholly) controls these. In this sense only is there hierarchical government or organisation of a society, but not otherwise, as will be shown presently. There is, as has previously been stated (page 137), a hierarchy of societies or events, ranging from the universal event, through nebulæ and astronomical bodies, to the earth and man and from him down through constituent organs, and colloidal aggregates, to molecules, atoms and finally electrons and photons. The life of man, the child of his mother, earth, is within her control, the control of her society (although he reacts with her as does, say, the human heart with man), as she likewise is controlled by the sun, the latter by the galaxy, and the galaxy by the universe, so that all in the end are controlled, but not wholly determined, by the universe.

We shall now consider the organisation of societies from the viewpoint of the constituents. In turn we shall examine that of an atom, of a molecule containing atoms of more than one chemical element, of a simple autocatalytic society, of a unit biological cell, and of the human autocatalytic society.

An "*atom*" of any chemical element with its single centrally-placed electrically-positive 'massive' "nucleus" and its outer thin mist of numerous electrically-negative "electrons" does appear, at first glance, to be entirely hierarchical in organisation. The "nucleus" appears entirely to dominate and to govern all its several attendant and servile "electrons". But this is not an accurate picture of the state of the society. The total negative electrical charge of the "electrons" equals the positive charge of the "nucleus". Thus the control of the electrons by the nucleus of an atom is in this respect mutual, not one-sided. On the other hand the high mass of the nucleus has no counterpart in the electrons. Thus although the nucleus is incorporated within the wave system of the whole society of the atom, none the less, to this extent it determines the behaviour pattern and character of the atom. However, as is well known to scientists, the electrons provide the medium whereby two or more atoms may be united together through the fusion of their wave-systems. The portions

of the atomic wave-systems most engaged in the exchange type of union of atoms, are the wave-systems of the binding pair of electrons, one from each atom or both from one atom, the two exchange electrons having antiparallel or opposite 'spins'. (According to the present hypothesis *the two binding electrons* are out of phase by half a wave-period of the short wave-change (S). This provides the *opposite* '*spin*'). The nucleus then does not entirely dominate or govern the behaviour of the electrons within the society of the atom. It is not only the nucleus which has an influence on the conduct of each electron, but each electron itself has an influence on the conduct of each other electron and on that of the nucleus. The mutual influence for each pair of "particles" is dependent on their being adjacent or more remote from each other, on the magnitude of the electrical charge, on the spin, and on the mass, of the "particle". The whole organisation is generally collective, with an appearance only, of a hierarchical influence of the nucleus on the remaining members of the society, the electrons. Any dominant influence, possessed by the nucleus over the electrons in the atomic society, is mainly due to its relatively highly condensed and formed mass, which according to the hypothesis corresponds to its highly condensed factors of will, intellect, and feeling.

As an example of a *molecule* containing atoms of more than one kind of chemical element we shall instance *ethyl alcohol*, containing atoms of carbon, hydrogen, and oxygen. The organisation or structure may be represented in terms of chemical symbols as follows:



Here one line represents a pair of binding electrons, one of each pair being derived from one of the two atoms represented as united by the line. The two electrons are bound by the exchange force of their opposite or antiparallel 'spins' and incor-

porate within their union the modified proper wave-systems (comprising both orbital and spin components) of the two atoms which are united. As represented, in such a structural formula, two adjacent atoms seem to be wholly bound together, excepting in so far as one or each of the two is bound to other adjacent atoms. Because of the many successful syntheses of organic compounds, arising out of the ideas furnished by structural formulæ, and also from the results of X-ray analysis of the structure of complex chemical compounds such as the phthalocyanines, which results largely confirm these structural formulæ, there can be no doubt that they are correct or at least largely correct. The latter alternative is accepted here since it seems possible, that although by far the main union is through the near-body or intense fields of the different pairs of binding electrons, yet there may be some very slight although almost imperceptible, mutual, influence or binding of every atom of the molecule by each of the other atoms, through their outer and much weaker fields as mesomerism (resonance) tends to show.

The effect of the terminal hydrogen atom linked to the oxygen atom, in the alcohol molecule, is to cause or to allow a slight but measurable displacement of the binding electron pairs away from the hydrogen towards the oxygen atom and this effect is partially transmitted to the α-carbon atom. Hence the terminal hydrogen "atom" acquires a fractional positive electrical charge, the α-carbon "atom" a smaller positive charge and the oxygen "atom" a fractional negative electrical charge. This polar effect is further transmitted weakly through the "molecule" from the α- to the β- carbon "atom" so that the latter acquires a weaker positive charge than the former and so that the whole "molecule" is electrically polarised. In terms of the psychic factors of will, intellect, and feeling, these have form and direction not only in the atoms composing the molecule, but also in the molecule as a molecule, that is in its proper wave-system. The society of the molecule is therefore disposed to act in a certain manner and in the manner of alcohols generally. Generally, although the hydrogen atom, coupled or united with the adjacent oxygen

atom, influences the behaviour of the neighbouring atoms and of the whole society of the molecule, there is no hierarchy here, but an organisation and government which is collective. The organisation is indeed almost entirely composed of strong local governments, the different inter-atomic bonds uniting adjacent atoms, so that it is almost entirely through and by way of these governments that member atoms may be supposed to communicate with each other. A molecular society is generally of this kind, its organisation being weakly collective, but exhibiting strong local government. The reactive centres are those where there is an excess of polarised and polarisable will, intellect, and emotion, corresponding to an excess of positive or negative electricity, etc., leading to activity.

The *simple autocatalytic society*, whose organisation we shall consider, will be that of the hydrogen acetate, ethyl acetate, water, and ethyl alcohol, system already discussed from another viewpoint in Chapter VI. Briefly, the autocatalyst, hydrogen acetate, has its will polarised or set, and more or less inflexible in direction. The autocatalyst may then be supposed to impose its will on the society of which it is a member so that as a result it generates more of itself, although at this lowly standard of 'life' there is little sign of intelligence or purpose in the autocatalyst. It is only when one reaches the standard of the virus proteins that reproduction, in autocatalytic systems, appears to be altered and adapted to suit changing conditions. Here, purpose and intelligence may be supposed to be used, although, if so, from scientific evidence, it must be by way of apparently random variation and *natural selection.*

It would seem that memory, involving intelligence and cognition, and thus the possibility of recognition, must at least be necessary for the autocatalyst itself, before it could itself have purpose sufficient to effect changes in its reproductive processes, as would be required by *Lamarck's Theory of Evolution. Darwin's theory of Natural Selection*, where 'nature' denotes the universe, would require memory and purpose only in the universe. This could be more readily agreed to, but the conditions required for

Lamarck's theory are much more doubtful. From the present conception of the universe (God) it would follow that universal memory provides for heredity, or the instinctive behaviour of species, be they electron or man; and that *random variation followed by natural (i.e., universal) selection is due to the 'universal' method of argument.* This method would appear to be:—for the universe to provide, through the influence of photons in any nebular event, *hypostatised 'ideas' (events) of all possible varieties,* varying around the mean of the parent species; and then to allow *these varieties mutually to compete* for 'food' or 'sustenance', that is, for the assimilation of other neighbouring species of events. The universal method of argument would thus always involve seeing all round an 'idea' before adopting the 'best' variety. It would be *a practical appeal to truth* in assessing the conformation of any variety of the original 'idea' to the universe of other 'ideas'; that is, to the other existing species necessary for its sustenance and propagation. *This universal method of argument or discussion, this universal logic would involve the evolutionary method of natural selection as otherwise described in the "Origin of Species" by Darwin, a century ago.*

In an autocatalytic society an individual influences the rate of change of the whole society, in favour of the reproduction of his own species. Simultaneously other species are produced—what we have called the by-products—and finally a dynamic equilibrium position is reached when as many individuals of the autocatalytic species are 'born', as 'die', in the same period of time. From the equilibrium state, it is clear that there is no true hierarchical organisation of the autocatalytic society, since the by-products here mutually and equally influence and control the autocatalyst. However, during the growth stage of the autocatalyst the society is controlled to a large extent by this species of individual. One may draw a parallel with the control by man of his own autocatalytic society, that of the Earth. But generally the different individuals of such a society influence each other mutually and the society is a collective organisation. That some individuals have greater influence than others is only to be expected when

they are of different species because this signifies widely different personal capacities of behaviour.

A unit *biological cell* is a complex society of individuals of many species and an air of mystery surrounds its organisation. It has been thought, on the one hand, that the nucleus with its chromosomes and constituent genes, controls or governs the rest of the cell, the more or less undifferentiated protoplasm or cytoplasm, although the latter is itself known to be an extremely complex society. On the other hand it has been supposed that the cytoplasm, at least equally with the nucleus, controls the behaviour of the cell. Professor E. B. Wilson (*The Physical Basis of Life*, 1923), whilst acknowledging our present ignorance of cell organisation, concludes that it lies in the ground substance, the hyaloplasm of the cell or egg, as shown in the following passages: "In the Ascidian, too, the striking visible pattern seen at the beginning of cleavage (of the egg) does not at first exist, but is swiftly built under the eye of the observer by streaming movements of the öoplasm that take place immediately upon entrance of the sperm into the egg. In cases like these, where the localising processes may readily be followed by the eye, the egg offers an impressive spectacle when busily engaged at its work of blocking out the embryo, without visible tools or model, but with an uncanny air of deliberation, purpose, and mastery of technique that any human artist might envy. Beyond a doubt the movements and regroupings of material which give rise to the visible pattern are expressions of an underlying more fundamental organisation that escapes the eye; *but it is precisely this organisation of which we are ignorant.*"

And again: "the visible patterns may in many cases be disturbed, or even almost obliterated by subjecting the egg to a strong centrifugal force (by which the formed bodies are displaced) without destroying the capacity for later normal development and often without serious impairment. Once more, therefore, we are driven to the conclusion that the primary basis of the egg-organisation lies in the ground substance or hyaloplasm; and that it is primarily the components of this system that are sifted apart

and distributed during the cleavage of the egg according to a perfectly definite order. The visible formed components follow this order; they do not create it. What then, constitutes the fundamental or primary organisation of the egg? No one is yet able to answer, the embryologist, the cytologist, the physiologist, and the biochemist—all alike have thus far only skirted the outermost rim of the problem."

Whilst this is true, yet the present hypothesis would point the way to a solution of the problem. The unity of will, intelligence, and feeling, of the whole person, the cell or egg, involving its hereditary characteristics, may be held responsible for the exhibition of "deliberation, purpose and mastery of technique" which it displays. In a way similar to that in which an atom or a molecule of hydrogen (as a portion of the universal event) displays heredity or racial memory because when newly-formed, it immediately behaves in a manner similar to that of other members of the species, so do all individuals of the same biological species. There will be more possibility of variation in the behaviour of the latter, because it is more complex, being a living individual.

To return to the point at issue, which is as to whether the organisation of the cell is hierarchical or collective, the answer must be that generally it is collective, but that locally the autocatalysts, which probably include the genes of the chromosome network, will exercise a dominating influence. This influence will be exercised on those species of individuals which have been chosen and permitted to pass into the cell society through the cell walls, as necessary and 'food' members of the society. However, the society will generally be collective in organisation as amongst the members themselves, because it is an autocatalytic society, and a society of this kind has previously been shown to have that kind of organisation. The proper wave-system of the society of the cell as a whole will exercise hierarchical control over all members.

Any *living organism*, including man, is not only a community of cells of the same species, which have developed along different lines depending on their several environments, but also a society,

which provides these different environments for the cells. *Goldschmidt's theory* that the genes are mainly, but not wholly, responsible for the course of development seems to be very probable in the light of *Mendelism and the modern theory of genetics* arising out of this. He supposes development to proceed by a number of parallel processes, each occurring in the response of a different gene in the original cell and later cells, to the different cellular food systems. The processes will be the equilibrium processes united within the wave-system of the whole society, the different genes, or individuals within the genes, being the catalysts.

We shall conclude, that, from the viewpoint of constituents of the same universal hierarchical rank (*e.g.*, in ascending order of rank: atoms, molecules, colloidal aggregates, biological cells, and multicellular organisms) but of different species, the organisation of all societies is collective and not hierarchical. The latter kind of organisation may appear to develop locally during periods of growth of autocatalysts, but these are reciprocally constrained by other members of the society. Communities and societies would therefore only be healthy when from the viewpoint of the constituents they are collective in organisation and government.

The Life and Death of a Community

If the argument in the foregoing pages is valid, then since living organisms do not live for ever, but have a mean life period varying with the species, it would follow that a community also has a mean life period varying with the species. The growth to maturity, followed by the decline and death of any individual living organism, is determined in part by the species, in part by the health, vigour, and temperament, of the individual, and in part by the environment. Death can occur before the end of the mean life period of an organism has been reached, by the action of enemies or due to lack of food. The proper wave system of one organ, such as the heart, may also largely determine the life-period of the whole organism. Placidity seems to be very impor-

tant for longevity; the mean life period of a diamond exceeds the bounds of human imagination.

It might therefore be valuable to make even more intensive studies, of historical records of the circumstances surrounding the decline of ancient and recent human communities, than have already been carried out, and with this thought in mind. It would appear that nothing can prevent the eventual decline and death of any human community, but questions to be answered are: (1) what is the natural life-period which a human community can expect? (2) what promotes its health and vigour? and (3) what environments, especially of the mind and spirit, promote longevity in a human society?

Finally, as living organisms have progeny, so it is possibly true that mature human communities may give 'birth' to, or produce, other human communities. Herein lies hope for mankind. It would appear that colonisation followed by the independence of the daughter community is a method of 'perpetuating' the life of any human community. This does not necessarily imply geographical colonisation, but the provision of sufficient novelty and variety of circumstances, for the new community, as to give it a real and vital interest in its own self-perpetuation and self-realisation.

The Organisation of the Universe

Before leaving the topic of the organisation of an event, whether it be a community, or a society, a short reference will be made to the organisation of the universe. The typical organs here are the nebulæ, of which there are untold numbers. We may call them angels, all largely controlling the actions of their constituent events, including other and minor angels, such as stars, planets, etc., and these including animals, plants, men, etc. Throughout the universe is the all-pervading influence of cosmon and photon space-times which may be termed the Holy Ghost. Any man (or any structural event) may regard himself, as Christ did, as the Son of God. This is not meant to be blasphemous, but to illuminate man's responsibility to himself and others. The

organisation of the universe—God the Father—is apparently collective so far as the organs themselves are concerned. It appears to be comparable to that of any other community or society, as for example the molecule of ethyl alcohol, or the organism of man. In each, there is a hierarchy of organs, but the organisation of these, at any one level or rank, is collective and not hierarchical. In each, 'organs' of lower rank, such as electrons, atoms, molecules, etc., are caught up into organs of higher rank, these into organs of still higher rank, and so on, and these again into the whole co-ordinated event. In this sense the heart, the brain, the liver, etc., of man, are akin to the nebulæ, the angels and ministers of the universe. There is a loose rein kept over all by this, although not transcendental to the constituents.

The question as to whether or not the universal event or God is ever conscious, in a way similar to that in which we, his sons and daughters, are conscious, is difficult to answer. His mind, (that is to say, He himself) must be conceded to be inconceivably more powerful than ours since we can little affect His universal change. But the organised constituents of our brains clearly differ from His organised nebulæ which, it is interesting to observe, tend in places to form clusters (see, however, page 136), possibly indicating further organisation. Nevertheless, if, according to the present hypothesis we can remove from our thoughts the scientific appearance and substitute the psychical reality of the universe, an overall high level of consciousness of a different variety is conceivably possible. Especially is this so when one remembers the enormous energy changes denoted by the stars (suns) and by the existence of supernovæ, the level of consciousness being the energy level of the proper wave-system of an event. Moreover, supposing man to be part of God, as we do here, it would be inconceivable that conscious knowledge, presumably of a higher order than that possessed by man, should not be possessed by God, for how else could consciousness have arisen in man? Whence could it have been generated?

The conception of the universe presented here is generally consistent with the God of Spinoza (*Ethics*, Part I, *Concerning God*).

CHAPTER VIII

GOD AND FREEDOM: MAN AND THE UNIVERSE

Freedom and Servitude

I profess now to have shown, in brief outline, that the hypothesis would link psychology with science, to their mutual reinforcement and to the better mutual understanding of psychologists and scientists. Its bearing on human understanding generally, on man's place in the universe, (already dealt with to some extent in the preceding chapters), on the possible existence of God and human freedom, and on the problems of good and evil, beauty and ugliness, intellectual truth and falsehood, will be outlined in a similarly brief manner in this chapter.

In the Old Testament, it is "the foolish man" who says in his heart "there is no God." In the New Testament and in the scientific world of to-day, it is the man "wise in his own eyes" who finds it difficult to believe in God. The world of science, with its "events" composed of electricity, magnetism, mesonism, and gravitation, appears to function adequately without any need of God.

One part of our hypothesis is that all events are regarded as constituent members of the universe or God, who is of the same essential nature with them. Far from being unnecessary, it would be unthinkable on this hypothesis for God not to exist. How otherwise, for example, can we explain heredity, and instinct, in both 'organic' and 'inorganic' nature? Thus man, like every other constituent event, is made, not in the "image of God", but "of God".

The main characteristic, distinguishing the universe from all events, is that of entire and absolute freedom from compulsion to behave as others would wish, although this freedom must be

conceived to be bounded by the necessities of His own prime nature. There are no 'others' (outside) to impose their wills on Him. He is quite free, and unconstrained by others (but presumably not by Himself), in this first freedom. In so far as the prime constituents of the universe, here considered to be mainly photon space-times and nebular, or electronic space-times, are almost entirely free from constraint, photons from other photons, and nebulæ from other nebulæ, so far would it appear that each has been allowed largely to enjoy the first freedom of the universe, and to be largely free from outside control. God alone of all persons, being quite symmetrical and thus without space and time, has no transcendental or proper wave-system imposing control from without on His constituents. He alone identifies Himself entirely with, that is, He alone is wholly immanent in, His constituents. Yet He maintains order. This complete self-immolation of God endows Him with immortality and endows us, His mortal constituents, with His essential quality of freedom. He may be supposed to have two freedoms;—the first, absolute freedom from external control; and the second, the small extent of freedom wherewith to control internal constituent events. so as to maintain personal unity. As we have seen, He alone of all persons appears to have foregone the second freedom and hence is immortal.

Any complex constituent event of the universe, from our knowledge of complex "events" in the scientific world, may be considered to be a society, community, or person, composed of simpler events, and these again of still simpler events, and so on, until electrons, photons and cosmons are reached as the simplest events. To be true to nature, it would appear to follow that the greatest possible measure of freedom should be given to constituent simpler events by each complex event, always within the social unity required by its own specific requirements and always remembering the limited yet varying capacities for freedom intrinsic in the very nature of all events. The problem for any community would then be to diagnose its own requirements, for only if these were known could the extent of freedom necessary

for its component members, and thus for its own fullest realisation and maximum health, be ascertainable. But in any community or person the conflict, of the two freedoms, must be reconciled by a balance of the two. And from the example of the universal community as pictured here, this balance should be in the direction of the first freedom for each constituent person. Only in this way would it appear that there could be any true solution to the problem of the conflict of the two requirements of (1) personal freedom (from external control) and (2) social control, the freedom of a community to exert control on the persons constituting it.

Anarchy, if this implies absolute personal freedom, cannot be a true solution, nor can rigid social control, if this implies an absolute negation of personal freedom within a community. The true solution must lie somewhere between those two extremes. It will tend towards the former rather than the latter, because all events, being parts of the universe must be supposed to possess a larger proportion of the first freedom than of the second freedom. This conclusion, at least in so far as it concerns human communities, was reached many years ago by John Stuart Mill in his famous essay "On Liberty". The pith of this is that freedom for individual diversity of thought and conduct is necessary for the health and vigour of any human community.

Good and Evil

Although in His absolute goodness, absolute because of His absolute freedom of choice (absolute, that is to say, within the necessities of His own nature), the universe may be supposed to have chosen the largest possible measure of freedom for all His constituents, yet this measure appears to differ, according to circumstances. This is shown in the world of science first and foremost by the herewith supposed transmutation in nebular regions of relatively diffuse but quickly moving, independent, and free "photons" and "neutrinos", into the relatively intense but intrinsically slow-moving and relatively easily swayed "electrons" and "mesons", and thereafter by the union or association of these into all the more complex "events". In other

words it is shown by the process of evolution, induced by the two main systems, the photon and the nebular, of the universe, providing an enormous number of different species and varieties of events. The slowing-down process inducing the integration of photons into more complex events, caused by the asymmetry of a nebula, is balanced by the quickening-up process inducing the disintegration of more complex events into neutrinos, photons, and cosmons, supposed to be caused by the 'momentary' and periodic reversion of any asymmetric nebular space-time to that of photon and cosmon space-times.

What can be the reason for these many different levels of freedom of constituent events within the universe, induced by the conjunction of the two main types of events? The answer that we shall return to this question is that they appear to be necessary for the universal purpose. We shall suppose that this purpose, like that of man, is to realise Himself as fully as possible. In order to appraise this we must consider *the divine factors.* These must be considered to be three in number, as all constituent events are here supposed to have three factors. They will be regarded as being absolute *Goodness, Intellectual Truth,* and *Beauty;* corresponding to the factors of volition, intellect, and emotion, of any constituent event.

If evil be the control by any person, of a person other than himself, either inside or outside him, because the first freedom of the second person is curtailed, then goodness can be measured by the degree of abstention from such control. God alone can then be seen to have absolute Goodness, as He alone cannot possibly control 'other' persons. Even the control of events within one's self must be accounted evil. Thus only He can have no sin and do no evil. But to realise the other divine factors more fully He must presumably render them more intense than in photons; and supposedly through the existence of nebular regions and the process of evolution. It is in this way that He may be supposed to have resolved the difficulty of realising His factors in a more intense form, and yet of keeping the possibility of evil down to a minimum for constituent events. One can only

presume that He adopted this solution to the problem of the inevitable incursion of evil into the universe, (evil, that is, from the viewpoint of the constituent events), to reduce this to a minimum compatible with the desired intensity of experience of Goodness, Truth, and Beauty. This 'universal mean' of behaviour is akin to the Aristotelian 'Doctrine of the Mean' that of compromise, involving virtue as a 'mean state' (*The Nichomachean Ethics*, Book 2, 1107a). Herein may be supposed to lie the dual aspect of the 'good life' for men, a minimum of social control from without, compatible with a maximum realisation of the divine factors within.

We have supposed that evil can arise only from the control of other persons, either by accident or on purpose. Purpose is not choice, or the exercise of will, alone; but it involves knowledge, for without the latter the will is blind. Neither is it emotion, nor reason alone. It is the conative process of the integrated cognitive-conative event. In his accidental constraint of persons man is constrained in his action by still other persons and so he does not truly control the former. *Both evil and good may arise out of purposive control of others*, according to our definition of evil, since this control may allow still another set of persons to be more free to accomplish their own purpose. Control of the first set is evil *for them* in so far as they judge that their fuller self-realisation is denied them, as it will be by outside control. For them it is evil. For the second set of persons it is good, in so far as they judge that their purposes may be more easily achieved. Only when there is purposive control of other persons can there be said to be evil and, even then, not wholly evil for some good ensues for some person. There would appear to be no absolute evil to correspond to absolute goodness.

The devil and sin within us appear to be derived, paradoxically, from the urge—inspired by that divine freedom, which in the Deity is absolute goodness—the urge to absolute freedom from constraint by others so as to be able to be free to realise ourselves. They are inverted goodness. They constitute the so-called 'original Adam' working within us; self-realisation at all

costs, including the control of others, if the others infringe or appear likely to infringe on this freedom and so to control us, and hence to limit the possibility of our achieving our own ends. It is the judgement which we are continually called on to make as to whether other persons by their behaviour will so control us or others, that we, or they, shall not be able as fully as we would like to pursue our own objectives, which on this view provides us with our opportunities of being good or evil. Now it is certain that *man's greatest freedom* to control himself lies within his conscious body of desires, ideas, and emotions, and not in his sensual field, for here perceptual sensa are 'given' to him, whether he will or nay. Thus his judgement of what is represented to him in his perceptual sensual field as occurring in the external world, should have reference mainly, but not solely, to this 'inner life' of mind and spirit where alone he can hope most fully to achieve self-realisation. If through perception or any other method of knowing he judges that his inner life, or that of others, is about to be threatened because of lack of sustenance either at the unconscious level of the whole man, who sustains him, or because of lack of sustenance at his conscious level, such as lack of adequate perception or adequate ideas and emotions, then he will form a judgement as to how to act. The judgement may be either to remain largely passive or to act, so as partially at least to control the circumstances. There is only a quantitative distinction here, because all judgements involve action although not necessarily action capable of being perceived in the external world.

For goodness to result, a man's decision apparently should be to act only sufficiently to control circumstances, which are always other persons, so that a minimum of evil results from this control and to allow him and them still to have that more intense inner life of the mind and spirit which appears to be the fuller realisation both of God and man. To strike the right balance is difficult, as we are all only too painfully aware, and it appears to be impossible to ensure that a minimum of evil results from our decisions and actions. For a decision may be taken on a wrong interpreta-

tion of our sensa or other items of knowledge or on insufficient evidence on which to base a sound judgement. Again, what we may think to be minimum control of other persons, may precipitate still greater control of them by others or indeed of others by them, although no sane person could have foreseen these greater evils as consequence. However, Aristotle's 'Doctrine of the Mean' is in agreement with what is apparently the universal solution of the moral problem, as has been previously indicated, and on this basis, it could be held to be true. Goodness in action must then be the result of complete knowledge and a right balance between the two freedoms for man.

The persuasive power of human wisdom (not just the cold logic of reason), alone should presumably sway the minds of men. The gross power of 'unconscious' mind, *i.e.*, of the body of man, or of the 'unconscious' bodies of his weapons surely need not be added, by man himself, to the control exercised over all men by the 'unconscious' persons of the universe, such as tempests, earthquakes, plagues, and diseases. Only by the persuasive power of ideas, which denotes their assimilation, due partially to the emotional responses which they evoke in man, may it be supposed that he can hope to achieve his own, and to this extent, the universal, purpose. For it is only within the conscious body (brain) of a person that the fullest freedom is attainable. As Whitehead says (*Adventures of Ideas*, Chapter 4), the distinction between the barbarians and Plato is that, for the former "his final good is conceived as one will imposing itself upon other wills" whilst for the latter tolerance and freedom are the basis of life, freedom being based on the essential spontaneity of the mind that is the person.

Here we have stated *the problem of good and evil.* From the hypothesis it would follow that the broad solution to the problem would be to concentrate on the development of the inner freedom of the human person, the human mind, for this would give maximum freedom for all men. This would involve a healthy 'unconscious' man as the basis for the 'conscious' man which would further involve problems of man's 'food' and 'health'

generally, including the more beneficial partial control by man, for man, of the Earth and possibly our galaxy. But it need not include undue competition or war or the exercise of brute force as between man and man. The fuller understanding of the equilibria between communities of individuals of different species, equilibria which embrace the problem of human 'food' and population, would be a great step forward to this end.

Truth and Falsehood

Following our hypothesis, the trinity of universal factors would be supposed to exist as the trinity of psychic factors in each person. Each divine factor would belong therefore to the whole person but each would reside in, and only be capable of expression through, one psychic factor. For goodness this would be the factor of will; for intellectual truth, the intellect; and for beauty, the factor of emotion. Each would reveal a different quality of the whole truth. Each factor, being inseparably linked with the other two, would always be influenced by them. Intellectual truth then could only reside in and be expressed through the factor of reason or intelligence but would always be influenced by the factors of will and emotion.

Intellectual truth would be seen to differ from the whole truth as does a concept from a hypostatised 'idea'. The latter would be a person, who could not be confined within the limits of the coldly logical intellect (I) but would require the wider reach of the whole cognitive-conative processes containing the 'warmth' of the factor of emotion (F). *Wisdom or the whole truth* would be the whole man, the 'heart' and spirit (VF), as well as the 'mind'. (VI). Intellectual truth (I) would be of the 'mind' only. For the building of any organism of knowledge mere intellectual ideas or concepts and the judgements of intellectual truth would seem to be insufficient. The appropriate emotional and volitional factors must be associated with any merely intellectual ideas if the latter are to be assimilated by and in persons (VIF) and therefore to live in them and in their memories.

Intellectual truth is expressed as judgements or propositions,

which are mental patterns in themselves, relating the conformation of different patterns of perceptual sensation, or of conception within the mind, to part of the general human conception of the universe. These more or less detailed mental patterns of perception and conception are detailed directional patterns analogous to those of magnetic fields; magnetism being supposedly the scientific factor related to the psychic factor of intellect. In the subject-object relationships of the verbal judgements of man lie the patterns corresponding to the judgements of the intellect itself. For intellectual truth is not so much in the verbal judgement but is the whole of the intellectual pattern whereby there is judgement concerning part of it and especially as to whether or not this conforms to part of the universe as conceived by man in general. A statement can at best only represent or symbolise the judgement of the intellectual pattern. The adjudged conformation, by a person, of a part of his intellectual pattern, with part of a consistent and coherent conception of the universe, is the intellectual truth for any person.

More generally, truth may be taken to be judgement, by a person, as to how far sensa, concepts, and events (*i.e.*, 'ideas' generally) correspond with or conform to reality, which is the universe. From this definition of truth, and assuming His existence, only the universe could know absolute truth because only He would be completely in conformity with, being identical with, Himself. His judgements of the degree of conformation of Himself with reality could not be anything but absolute truth. There could then be no falsehood, no deceit and no lying with Him. All that would be presented to Him would be Himself. Nothing would be represented and therefore nothing could be misrepresented. He would be absolute Truth, intellectual, æsthetic, and moral.

In order to realise, *as fully and as intensely as possible*, absolute intellectual Truth, as has been related for Goodness, He is conceived to attempt to realise the second kind of freedom, within the constituents, at the partial sacrifice of the first kind of freedom for them. There are presumed to be an indefinitely great number

of such attempts proceeding simultaneously in different nebular regions of the universal wave-system, in dynamic equilibrium with a similar number of reversals of this process, and where almost complete freedom of the first kind is restored, at the sacrifice of the second kind. The second kind of freedom may be presumed to have its supreme embodiment on Earth in man. Here then, due to the freedom of man to control his intellectual processes, intellectual truth should be revealed in clarity and in sharply defined patterns. In a way this is so; but with the partial loss of the first freedom, man is conditioned by other creatures and hence his intellectual patterns and especially his sensa are supposedly only representative of those of the universe. In this way the acuity of man's intellectual judgement or possession of intellectual truth would appear to be neutralised by the mere appearance of reality in the clear-cut patterns of his sensa. For the patterns at any level include in themselves the intellectual judgement at that level.

The degree of falsehood in any judgement in man's mind will be proportional to the degree of representation, as contrasted with presentation, of reality. The degree may be measured, at least in part, by the lack of freedom of control which man possesses over his parts. This lack of freedom of control is most evident in his sensual field where the patterns of the sensa are given, are intuited, and cannot be re-arranged by a conscious act of will. Thus in the sensual field a large degree of representation would be expected. On the other hand in the human brain (not "brain"), where there is freedom of control of a high standard, we should expect to find only a low measure of representation and a high measure of presentation of reality, the reality of man himself undetermined by others. Therefore the judgement inherent in the human brain may approach to absolute truth, whilst the judgement within the sensa of man's sensual field will be wide of absolute truth as we have defined it. Any sensum will be true, but only fractionally true. Thus the judgement or truth revealed in sense-perception, the truth of the world of science or art or music, will only be truth in so far as it is a judgement

within its compass. This field truth we have supposed to be different, not merely quantitatively, but qualitatively, from the truth of the brain (body) judgements of a person.

The qualitative distinction between these two kinds of judgement or truth, the low-grade truth of sensa and the high-grade truth of the brain (body) has by no means been clear to men. Human perceptual sensa have been so insistent in their 'given-ness', in their clarity and brightness, in the interest and attraction of their patterns, that the higher intellectual, moral, and æsthetic, judgements of men, with their less apparent but deeper interest and greater reticence, have been less recognised in general by them. The perceptual judgements of sensa have been accepted by men at their face value because of their insistent given-ness. Thus these judgements have come to be regarded not only as being true, which they are, but as being judgements of the highest grade of truth. This is where, according to our hypothesis, mischief is being done to men through the inferences drawn from science concerning the nature of ultimate truth or reality. The perceptual judgements of sensa are true, but false. They are true in themselves but false in not conforming more fully to essential reality. As judgements they are concerned with pronouncements concerning one only of the three psychic factors, and this an etiolated field factor, namely that of intellect, the others of the trinity, volition and emotion, being outside their ambit. Their inadequacy concerning reality is exposed when the perceptual field is examined and judged by the more complete brain (body) judgements of men. The trinity of prime psychic factors in other (external) events is then espied, disguised as the trinity of prime scientific factors, within the low-grade judgement of perceptual sensa. In other words, the factors of will, intellect, and emotion, revealed in brain (body), cognitive-conative, judgements as real, and partaking of the nature of the trinity of divine factors, goodness, intellectual truth, and beauty, discover the trinity of prime scientific factors; of electricity, magnetism, and mesonism, in the perceptual judgements of sensa.

With truth, and its companion, falsehood, of greater or less

degree, we shall not further concern ourselves, but shall be content to have related the two former to our main hypothesis and in broad outlines. As Whitehead has so well said (*Adventures of Ideas*, Chapter 16), "But after all, it is the blunt truth that we want. The final contentment of our aims requires something more than vulgar substitutes, or subtle evasions, however delicate. The indirections of truth can never satisfy us. Our purposes seek their main justification in sheer matter-of-fact. All the rest is addition, however important, to this foundation. Apart from blunt truth, our lives sink decadently amid the perfume of hints and suggestions."

The blunt truth that we require is the conformal correspondence of clear and distinct appearance to reality. In popular human experience, clear and distinct appearance is commonly held to reside in the judgement of perceptual sensa. In this section we have been engaged on the presentation of what is here considered to be the 'blunt truth'. We have shown that on our hypothesis the field judgement of perceptual sensa although analogous to that of the full-bodied cognitive-conative judgement, is only a pale representation of this. The representation of persons within the incomplete judgements of perceptual sensa is that of cold automata, statistically determined in their actions and composed of the trinity of prime scientific factors. The brain (body) judgement reveals these same persons as beings pulsating with mind and spirit and having free-will and purpose, even though these are admittedly limited in scope; beings composed of the trinity of psychic factors of will, intellect, and emotion, and living within the whole pulsating universe of the trinity of divine factors of absolute goodness, intellectual truth, and beauty.

The reason why truth is commonly associated with the intellect is that intricate patterns are possible only for this open-textured factor. These allow of their symbolic and verbal representation in the form of detailed patterned judgements of the subject-object kind, which however cannot adequately represent moral and æsthetic truths because of the feebly patterned nature of the factors of will and emotion. The whole truth, invol-

ving all three factors, can therefore never be stated, but must be the judgement of the complete and not merely the intellectual, conscious experience of man. In this, and in the impossibility of adequately objectifying the will and the emotions, lies the impossibility of adequately *stating* in a verbal proposition, as distinct from experiencing, the whole truth. Further the whole truth referred to here is that available to man in himself. This must necessarily fall short of the absolute and whole truth of the universe.

Beauty and ugliness

Beauty is here supposed to be the divine factor or absolute value related to emotion, and to mesonism. The emotional content of beauty associated with a sensum is in the brain (body) of the percipient and not in his field, in the sensum. Representative form only, of beauty, is in the sensum. However beauty does lie, both in the emotional form within the brain (body) of a person and in the perceived form of the sensum of his sense-field and therefore of the person there represented.

Beauty is not patterned logically like reason or intellect. Beauty, which is æsthetic truth, and intellectual truth, although always inseparably united through goodness or moral truth, are poles apart. The one is irrational, the other rational. They may and must influence each other, being, as we suppose, two of the universal and inseparable factors within each person, but they are quite unmistakably distinct in quality so that beauty should never be mistaken for intellectual truth nor intellectual truth for beauty. Neither should be mistaken for goodness, for this also, with its essential quality of will, is unmistakably distinct in quality from both. Beauty must be considered to be associated more closely with goodness than with intellectual truth, from the integration of the prime psychic factors in the order, emotion-will-intellect. It is at least partially lost if one attempts to cogitate it through the intellect. It must be perceived or felt as beauty to remain beauty. It apparently cannot be analysed intellectually and remain beauty.

Beauty may be experienced by way of visual and aural sensa, provided either by nature or by art. But this must, on the sensum theory, be considered to be beauty based on the incomplete representation of being or reality; it is beauty based on empirical knowledge. Like the truth revealed to scientists in their interpretation of the external world, so the beauty revealed to artists, poets, or musicians, through their visual or aural sensa is only a partial revelation of the more complete beauty. This is beauty inspired within the brain (body) as the accompaniment of intuitional knowing. Nevertheless, beauty of "form" is very much the same as beauty of form. There seems to be a mutual and reciprocal inspiration of intellectual truth by beauty and of beauty by intellectual truth, through the intermediary factor of goodness, in the quiet contemplation, better called enjoyment, of man the seer, the artist, the poet, the musician, the scientist or the philosopher. This act of enjoyment, or self-creation, may indeed be regarded as his highest level of self-realisation.

What of the divine factor of absolute beauty? Of what does this consist? It may be supposed to be the emotional factor within the continual process of self synthesis or creation or enjoyment which is the universe. This is entirely free and unconditioned (at least by others outside) and therefore the continually effected self-creation must be entirely self-enjoyment with no element of discord or sorrow. No hate being possible, no trace of ugliness, which is associated with hate, can be present to mar or tarnish the beauty of the emotional form. Thus the universe must be considered to possess absolute beauty or æsthetic truth as the third divine factor. The problems of love and hate, and of beauty and ugliness, are related to those of good and evil, and of intellectual truth and falsehood. They face us because of the postulated absolute factors of God. The problems are these: if He possesses absolute beauty, that is to say, if He is entirely free from ugliness, and yet all is God, where then does ugliness, the opposite of beauty, spring from within Him. In a similar way, if God is absolute love, how can the opposite quality of hate arise?

The solution to the problems will be derived from the argu-

ment used earlier to explain the existence in all creatures of the pairs of opposites, namely of freedom and determination (or 'slavery') of good and evil, and of truth and falsehood. Because of the partial lack of the 'first' freedom all persons are in some degree 'slaves'. This they tend to resent presumably because, as part of Him (the absolutely free) innately they feel themselves to be free. Where conditions allow them a large measure of freedom of self-control and self-realisation, their feeling to others generally is that of love. Where conditions are the opposite, then their feeling tends to be, in proportionate measure, that of hate or resentment. 'Feeling' here is a term for the conative process and involves both will and emotion. Love and hate relate to the whole conative process, but beauty and ugliness relate only to the factor of emotion. Thus hate within a person is his feeling of being constrained by others; love, his feeling of being free and unconstrained. Whether or not greater or less constraint results from these feelings is beside the point.

Beauty and ugliness are different polar tendencies of the emotional factor only, within the conative processes of love and hate respectively. Within man, of all terrestial creatures, the ideal of beauty is presumably most fully and acutely or consciously realised. But because of partial lack of freedom in man, least in his brain (body) and most in his sense-field, ugliness is also there. The purpose of man to achieve self-realisation, would then appear at least partially to be the development of the inner beauty resulting from self-creation in his brain (body) and involving all three psychic factors.

Since any process of living, even eating and drinking, is a process of self-creation, so beauty and ugliness will come within our experience. But true beauty, as has been explained, is devoid of desire or passion and thus of the factor of will. Hence eating and drinking, which involve this factor cannot be expected to inspire the highest beauty. Nor can any other process of living where possessing, which involves the act of will, is largely involved. This is the reason why vision and hearing may more readily produce beauty or emotional form within us, since they

are more free from the factor of will. Beauty in itself is considered to be without desire. In so far as sculpture or painting or music or poetry stimulate self-creation of the kind associated with the feeling of love, within the viewer or the listener, as within the original creator, then beauty will arise.

These ideas on beauty, arising out of our hypothesis, supplement the views of Kant in his *Critique of Judgement*. To quote from the article on 'Aesthetics' in the *Encyclopædia Britannica* (14th Edition), "As against the utilitarians he showed that the beautiful pleases 'without interest' (*i.e.*, utilitarian interest); against the intellectualists, that it pleases 'without concepts' and further against both, that it has 'the form of purposiveness' without 'representation of a purpose'; and against hedonists, that it is 'the object of a universal pleasure'." Beauty then is without intellect, purpose, will, or passion. It is both emotional and sensual form associated with the feeling of love. It is not always sensual and indeed at its highest is emotional form associated with goodness and with intellectual truth.

CHAPTER IX

CONCLUSION

OUR objective throughout this volume has been to attempt to unite psychology and science in the hope that the synthesis, if confirmed, would help the work of scientists and psychologists and might also help in restoring contemporary man's confidence in his general powers of understanding.

One of the main difficulties in the discovery of the link now proposed between them, has been the identification of the cloak hiding it. The cloak was eventually detected as 'matter', one of the two 'substances'—the other being 'mind'—of Cartesian psychophysical dualism. As Berkeley made clear, 'matter' is not something 'substantial' underlying sensa, and does not exist, except as sensa. With the elimination of 'matter' from the scene and the consequent formulation of the main hypothesis, the no-longer-hidden link was revealed. The main hypothesis from which the link is derived is that "*all events (subjects and objects alike) in the universe, are events of knowing*" where 'knowing' is 'active experiencing' or consciousness. It was inferred from the observation that the object of an event of sense-perception appears to have the same general qualities (of extension, and of the power of experiencing and causing orderly change) as the subject.

It was also demonstrated, by following a path already made clear by others, including Professor Broad and Mr. Bertrand Russell, that the first knowledge of other events is obtained by any event through the sensa of its sense-field, and that they do not present but represent the events known. Thus any inferences regarding the nature of the really fundamental factors of the universe, by scientists, from the qualities of sensa, must be accounted unwarrantable and unjustifiable. The scientific factors refer to sensa and can only be the factors of sensa.

The final stage in the argument followed, because, just as sensa merely represent events, so the three prime scientific factors (of sensa) must represent the prime psychic factors (of events). The latter may hence be deduced as being probably three in number. It is unnecessary to suppose initially that there are more. There cannot be less. Confirmation, that the number of psychic or scientific factors is three, was provided later from consideration of the wave-particle nature of fundamental particles. By comparison with the recognisable properties of the scientific factors, it was decided that the really fundamental and substantial factors of events are the platonic psychic factors of volition, emotion, and intelligence. They are represented in sensa, by the scientific factors of electricity, mesonism, and magnetism, respectively.

From the argument it seemed quite possible that here was the required synthesis, but confirmation was lacking up to that point, namely the end of Chapter IV. By reason of its nature, the hypothesis (including the derived link between science and psychology) is well-devised for confirmation or refutation. Its implications, when developed, can be checked against the evidence of science. This is the usual method of science with a hypothesis, and herein lies the virtue of our proposition as a philosophical principle. It can be subjected to a check in the scientific realm of experience. The necessary check has been made and confirmatory evidence, establishing at least to some extent, the validity of the hypothesis and the link, has been afforded in the last four chapters.

In these chapters are presented interpretations, flowing directly from the hypothesis and a dependent theory of mass-space-time, of (A) a wide range of scientific problems and large groupings of scientific phenomena. The problems include those of the wave-particle nature and the wave-motion of "fundamental particles"; the relationship of gravitational to electrical, mesonic, and magnetic, fields; the relationship of the "photon" to the "electron"; the rotation and revolution of the earth; the running-down of the world entailed in the concept of 'entropy'; the red-shift phenomenon; the emergence of novelty in evolution; and the

nature of 'life' and biological organisation. The interpretations are in agreement with the following scientific principles and laws: Planck's quantum theory, Heisenberg's principle of indeterminacy, wave-mechanics theory, field theory, relativity theory, the principles of physical and chemical combination, and the Darwinian theory of natural selection. Interpretations have also been given of: (B) the elementary bases of psychology in terms of three factors: volition, intellect, and emotion; of, (C) human social problems including the growth of population, and the organisation of communities and societies; and of (D) universal problems, including the origin of the ideals of freedom, beauty, truth, and goodness; and of their opposites, namely slavery, ugliness, falsehood, and evil. I feel, therefore, that it may be agreed that considerable evidence, in confirmation of the link proposed between science and psychology, has here been presented. Being capable of such an all-round range of application, in the scientific world especially, and in the universe generally, it is felt that it can be regarded as lying near to the centre or heart of truth. Of this the very weight and range of the evidence convinces me, as I trust it will convince others.

Progress resulting from its application would follow from the closer general correlation of psychology and science, but especially from their closer correlation in the study of the living human brain and "brain" and probably of the "electronic brain" It would now be possible for the objective method of science to be developed rationally in psychology. The new theory, if it may be so designated as a hypothesis which has been shown to be capable of wide interpretative scope, would give to psychology the inspiration, previously lacking, of knowing that it was justified in *assimilating* to itself all scientific knowledge, whilst reciprocally the pulse of science could not fail to be quickened.

To conclude, according to the view which has been outlined in this book, man is an intellectual and moral being in a stupendous and richly varied yet orderly mental and spiritual universe. He is powerful, but far from all-powerful. He has discovered how to split the atom, but not how to halt the stars in their motions,

nor how to cause our Galaxy to deviate in its course. Of the major rhythms of the universe—of life and death, of space and time, of the emotions, of the will, the intellect—man has, as yet, little or no knowledge and correspondingly little control. Man the microcosm, is but a microcosm. Yet his capacity for comprehension is amazing in its depth and reach as shown by his profound investigations in so many fields of human activity. What does the future hold for him? The abounding advances of science especially in the first half of this century, whilst providing the creature comforts of our civilisation, have been devastating in promoting the growth of a non-moral materialistic determinism in men and in facilitating wars between them. If, as we have attempted to show, psychology is now in a position to receive the tremendous impetus of science, then its advances in the remaining half of the century might be expected to bring, as abundantly, the spiritual balm required to heal mankind's present self-inflicted wounds. Quickened to health and sanity, man could then put folly from him and learn to increase in wisdom, through his continually growing knowledge of the 'external' and the 'internal' worlds, of God and of man.

APPENDIX I

THE WAVE NATURE OF EVENTS

IN terms of mass, space, and time, an event *is* its substantial space-time. It may be supposed to consist of two components, a time, orbital or long (L) and a space, spin or short (S) wave-change; the volitional factors of which are in planes that are at right-angles to one another and where 'long' and 'short' refer to wave period and not to wave-length. θ being the helix angle, (Figure 3) ϕ the phase angle and m_0 the constant total substance or mass of an isolated event, then the ratio m_L/m_S of the mass components (see page 230) associated with these changes has been found to be $\tan^2\phi/c^2$, $= \tan\theta$, and will be constant. The sinusoidal wave-changes in the factorial magnitudes, *within the constant masses* of the two component changes (L and S), would be denoted within the expressions representing these constant masses, namely:

$m_L \sqrt{\sin^2\beta + \cos^2\beta}$ and $m_S \sqrt{\sin^2\alpha + \cos^2\alpha}$ respectively, where β is the phase angle varying continuously through the range 2π for the orbital wave-change (L), and α is the phase angle for the 'spin' wave-change (S). The two expressions, $m_S \sin\alpha$ and $m_S \cos\alpha$, would show the factors of emotion and intellect, and also the two components of the factor of volition, as being out-of-phase by quarter of a wave-period (page 96), in the duplex conative and cognitive component processes of the 'spin' wave-change. Similar inferences can be made from the corresponding expressions, $m_L \sin\beta$ and $m_L \cos\beta$, for the orbital wave-change.

Since all three factors are, at bottom, bipolar, these results would hold good for each of them. But the bipolarity of the factor of emotion would only become evident in a complete long wave-change and therefore, for reasons already given, for

no constituent event in the universe. Neither is it exhibited by the universe itself for reasons advanced on page 131. Such a change of polarity involves the *death* of the event concerned. In one half of the wave-change (L) that is during the life-time of any kind of constituent event, the factor of emotion will impose its characteristics of extremely slow unidirectional fluctuation on the other two factors; much as the factor of intellect is here supposed to exercise its rapidly fluctuating bipolar influence on the factors of will and emotion, within the short wave-component (S) of the event.

Mass-space-time relationships of fundamental particles

$$v_L/v_S = c^2 \cot^2\phi, \quad \text{for any particle,}$$
$$= c \cot\phi / (1/c \cot \phi), \text{ see p. 231,}$$
$$= c/(1/c), \quad \text{when } \phi = 45°.$$

But $v_L = c$, is the known value for a free photon.

Thus $\phi = 45°$ *for a free photon.*

And $v_S = 1/c$ for a free photon.

$\therefore\ v_L\, v_S = 1$ for a free photon.

But $v_L\, v_S$ = constant for any particle.

From the photon

evidence $v_L\, v_S = 1$ *for any particle.*

Because $v_L \sim 0$ is the value for a 'bare' electron,

then $v_S = 1/v_L \sim \infty$; $\therefore\ \cot^2\phi = v_L/v_S\, c^2 = 0$;

And $\phi = 90°$ *for a 'bare' electron.*

When $\phi = 0°$ is postulated for a cosmon,

then $v_L = \infty$, $v_S = 0$, *for the cosmon.*

Because $m_S = m_L c^2 \cot^2 \phi = m_L\, v_L{}^2$ for any particle,

thus $h\nu = \epsilon = m_S = m_L c^2$ *for a free photon, where h is the Planck Constant.*

Since $h\nu = \epsilon = m_S = m_L c \lambda\nu$,

$\therefore\ h = m_L c \lambda$.

By an '*ordinary electron*' is meant a 'bare' electron associated with a photon, the union being by way of a loose co-ordination of the orbital and spin wave-components.

The Constancy within change, of an event

The energy of any photon equals $h\nu$, where h is the *Planck Constant of Action.* Thus we may say that h equals the expression $m_L c\lambda$. The *constancy associated with the flux of any event* (complex events being composed essentially of the smaller events, photons, 'ordinary' electrons and positrons), which has figured largely in the development of the hypothesis, would then be capable of being related to the fundamental universal constant h. This would give significance to *the ubiquitous presence of the Planck Constant in events,* all of which nevertheless continually undergo wave-changes as shown by this expression for h.

Heisenberg's Principle of Indeterminacy or Uncertainty

The expression, $ih = m_L c.\ \lambda$, where i is the square-root of minus one, is *the de Broglie equation* relating the wave-length, λ, to the momentum, $p = m_L c$, of an event, which equation provides a way of looking at Heisenberg's Principle of Indeterminacy or Uncertainty. For the expression, $p\lambda/2\pi = ih/2\pi$, completely defines in scientific terms, *the condition, at any moment,* of an isolated fundamental particle. The term "indeterminacy" would then be supposed to have the meaning commonly given to it, when it refers to the product, $\Delta\ \lambda\ .\ \Delta p$, of the indeterminacies of measurement, of the position and momentum of a particle, which is not isolated because its properties are being measured. The product would be seen to have the minimum value of $ih/2\pi$ because this is the value for any isolated event. It would now be revealed, however, that the centre of an isolated particle traces out a clearly defined wave-path. There would be no uncertainty, indeterminacy or mere probability about that. The minimum 'uncertainty' expressed by the quantity, $ih/2\pi$, for any event, would also be the 'condition' or constitution expressed in terms of mass-space-time, at one instant, of the fluctuating yet constant, wave-like yet particle-like, event. There would be more uncertainty, about the position of the centre and the momentum of an 'ordinary' electron at any moment, because it is no longer an isolated particle but one associated with a photon for pur-

poses of measurement. But it is certain that $ih/2\pi$ describes the minimum indeterminacy.

Particle Spin

The "spin" of an electron would be interpreted as its relatively unsubstantial space wave-component of rapidly alternating polarity. *The "spin" of protons* within the molecules of ortho- and para-hydrogen, and of all fundamental particles, together with their wave-characteristics, would be similarly interpreted, but there will be more complexity in this spin, because of the greater complexity of the particles, relative to an electron.

The equation $qp - pq = ih/2\pi$

The interpretation of the above equation, in which q and p are co-ordinates and momenta respectively and i is the square root of -1 follows readily from our picture of the 'bare' electron and positron. Although the components of these oppositely polarised particles are of the same magnitude yet they are integrated in opposite ways so that the particles are related as a right-hand to a left-hand helix. Where $p = m_L c$ and $q = \lambda$, then $qp = ih/2\pi$. *The electron and its mirror image the positron will be represented by qp and pq respectively.* The potential energy at one instant, that is the potential, at one point of a field of any ordinary complex event composed of electrons and positrons, will be capable of representation through the expression, $qp - pq$, which is *not* a difference between two quantities but represents a dynamic equilibrium as discussed on page 144 for a gravitational field and on page 237 for electrical, magnetic, and mesonic fields. Hence this expression becomes $ih/2\pi$ in terms of kinetic energy at one instant, that is in terms of the constant of action h. The factor i would indicate the very rapidly oscillatory nature of the spin change (S) modifying the orbital component (L) of the substance of the event at any point in any of the four kinds of fields.

A third kind of 'particle': Cosmic Rays (*see page* 130)

In order to explain the reversible transformation of a positive to a negative 'particle' (electron or photon) we must postulate

the existence of a third phase (or kind of 'particle') of the fundamental particle, and this phase must be neutral to allow of the required inversion of polarity of the two other kinds of 'particle'. Now the neutrality of such a particle on present theory is possible only where θ, the helix angle, is zero. The characteristics of this third kind of particle—which can be tentatively termed a *cosmon*—will therefore be:

$$\phi = 0;\ v_L = \infty,\ v_S = 0;\ m_L = 0,\ m_S = m_o.$$

It is clearly a 'particle' of striking differences from an electron, being neutral, of infinite or almost infinite orbital speed, of no 'rest mass' but constituted entirely of 'inertial mass', and having a ratio t/l of value infinity. It is probably the 'particle' source of cosmic rays. It would have a very transient existence, plus tremendous speed, ($v_L = \infty$), and being formed in the reversible electron to positron change during nova and supernova formation, would have it origin in general 'outer space', *i.e.*, in the universe or cosmos generally.

This third phase will be very unstable because emotion, responsible for the time (L) change of a particle, has been shown to be characteristically compact whereas in this 'particle' it will be very diffuse ($v_L = \infty$), and similarly the factor of intellect responsible for the space (S) change of a particle has been shown to be characteristically diffuse whereas in this 'particle' it will be very compact ($v_S = 0$). It may therefore be inferred that this 'particle' or phase exists only very fleetingly and that *its stable modifications are the two photon phases*. Neglecting their polarity, the two main phases of the fundamental particle are thus the photon and electron phases.

Any kind of typical cosmic ray particle or *meson*, regarded here as an association (through orbital union) by pairing of positive and negative electrons, is presumed to be produced reversibly by phase change from a *neutrino*—an association (through spin union) by pairing, of positive and negative photons, each possessing the minimum critical energy. That is 'pure' photon, as well as electron, 'structural' associations as presumed to exist up to this level of complexity, but photon union is mainly through spin, in which resides almost all the photon mass.

APPENDIX II

THE RELATIONSHIP BETWEEN SIMPLE EVENTS

If, as we have supposed, a 'bare' electron (positron) is a transformed photon then their characteristic differences must be capable of explanation. Any "electron" differs from a "photon" in having a *constant rest mass* and a constant electrical charge.

The *constancy of the magnitude and polarity of the electrical charge of an* "electron" (positron) will now be explained. The constant magnitude of the total mass or substance, of rapidly fluctuating direction within the spin wave-change and of slow-change in one direction within the orbital half wave-change of a "photon" has been explained (Appendix I). The kind and constancy of polarity of the electrical charge of the bare "electron" or "positron" is due to the manner and constancy of integration of the directions of the orbital and spin wave-changes within the event during half of the long wave-period (Appendix IV). Thus an "electron" has an electrical charge of fixed polarity. This charge, e, will show a constant ratio to the rest mass, m_L, of the bare "electron" because it is the 'substance' of the electrical factor, one of the factors constituting this constant mass and is always itself a constant. It will be possible for equal electrical charges each of magnitude e, but of opposite polarity, to exist in the ordinary "particles"—"electron" and "positron"—travelling in the same direction for reasons given in Appendix IV. The direction of motion of an ordinary electron will be due to the associated photon. Since any "particle" is polarised, any "*photon*" must possess a unipolar electrical charge of constant magnitude, this being either negative or positive. Like its rest mass and for reasons just given, it will be very small, and will normally be imperceptible.

When an ordinary "electron" acquires an additional quantum

of energy (photon) ϵ then, although an increase in velocity and in inertial mass, m_s, will occur, there will be no corresponding increase in the rest mass m_L and therefore no increase in the electrical charge, e. The ratio e/m_0 will therefore decrease as is in fact, observed. If v_L increases because the particle is situated in a field, then whilst m_L remains constant, m_s will increase since $m_s = m_L v_L^2$, and e/m_0 will decrease.

Theory of pair production

The production of a pair of particles, a positron and an electron, when a photon of minimum energy, $\epsilon = 2m_0c^2$, (where $m_0 \sim m_L$ the rest mass of an electron) interacts closely with an atom, is usually interpreted by Professor Dirac's theory. This is based on the idea of electrons being capable of existing in *states of negative energy*. Then they are assumed to be unobservable. Any one of these electrons, on absorption of sufficient energy (minimum $\epsilon = 2m_0c^2$) moves away into a *positive energy state* and so becomes observable as an electron, whilst the hole or empty place, which it leaves behind, becomes observable as a positron.

The present theory of the nature of fundamental particles, including electrons and positrons, cannot be reconciled with this basic idea of his theory. According to the present absolutist theory the positive and negative energy states required of events by any relativistic quantum theory, such as his, are to be found in the very polarities and constitutions of events themselves as illustrated by the positron on the one hand and the electron on the other.

From the discussion of plane-polarised light on p. 174 it is evident that negative and positive photons may become associated, under suitable conditions, to form 'photon pairs'. Such a photon pair, having energy equal to, or exceeding, $2m_0c^2$ will be supposed, under the influence of the very highly 'curved' space-time of an atom, to be converted into an electron and a positron, that is to say, into an electron pair. Any excess of energy remaining from the original photon pair will be absorbed by (unite with) the pair of electronic particles. The greater the 'curvature' of the atom, that is to say the greater the mass and atomic number, the higher will be the probability of electron pair production.

APPENDIX III

SENSE-FIELDS: THE BODIES AND FIELDS OF EVENTS

The cognitive (VI) processes produce, but the factor of intellect alone constitutes, the sense-field of an event. Moreover a very small part only of the field of this factor, will constitute the *sense-field* of a complex event. Within this, the sensa, representatives of external events, will be projected. This would be the basis of the explanation of the instantaneous formation of his sensa within a man's sense-field even at distances incalculably remote from him. The necessary focusing apparatus, to give the wonderfully accurate spatio-temporal representation, through sensa, of events in the universe, can only be attributed to the sense-organs, the nervous system, and the brain. Sensa would only be formed when photons, or energy quanta, are united with the appropriate brain centre of a man, because only then would new brain events be formed. This is a requisite condition for the unsubstantiality, rapid change, and extension, of the sense-field.

The mass-space-time relationship as it affects body and field.

The ratio c, between electromagnetic and electrostatic units will be taken to signify, since mesonism is of shorter range than electricity, and electricity than magnetism (a symmetrical relationship being thereby suggested) that the ratio of intrinsic extensiveness, that is the ratio of the units of extension—the extension for the same mass of factorial substance—of these factors is given by:—

magnetism M (intellect I) : electricity E (volition V) : mesonism O (Emotion F) : : c : 1 : 1/c.

That is :

$$\frac{\text{unit of extension of I (M)}}{\text{unit of extension of V (E)}} \Big/ \frac{\text{unit of extension of F (O)}}{\text{unit of extension of V (E)}} = \frac{c}{1} \Big/ \frac{1}{c} = c^2$$

Thus for both the spin (S) and orbital (L) components of an event:—

intrinsic t/l

$$= \frac{\begin{pmatrix}\text{unit of extension of I of}\\ \text{cognitive (VI) process}\end{pmatrix}}{\begin{pmatrix}\text{unit of extension of V of}\\ \text{cognitive (VI) process}\end{pmatrix}} \Big/ \frac{\begin{pmatrix}\text{unit of extension of F of}\\ \text{conative (VF) process}\end{pmatrix}}{\begin{pmatrix}\text{unit of extension of V of}\\ \text{conative (VF) process}\end{pmatrix}} = \frac{c}{1} \Big/ \frac{1}{c} = c^2$$

The unit of extension of the factor of volition will be the same in both duplex *processes*—cognitive and conative—of either component; but cannot be the same in the two *components*. Here the ratio of extension (orbital) to extension (spin) of the factor of volition is $c^2 \cot^2 \phi$ (see below). The ratio (t/l) of actual extension will vary according to the mass proportions, that is the phase angle, which is to say according to the value of α (for the spin change) and of β (for the orbital change). The ratio for the cognitive process of either component will be proportional to c cot α (spin) and c cot β (orbital). For the conative process the corresponding ratios will be 1/c cot α and 1/c cot β.

Hence for the *spin component:*

$$\textit{actual}\ t/l = v_{VF}/v_{VI} = m_{VI}/m_{VF} = c^2 \cot^2 \alpha$$

and for the *orbital component:*

$$\textit{actual}\ t/l = v_{VF}/v_{VI} = m_{VI}/m_{VF} = c^2 \cot^2 \beta$$

Similarly for a fundamental particle, *i.e.* an *event:*

$$\textit{actual}\ t/l = v_L/v_S = \frac{m_S\ (\text{induced by I})}{m_L\ (\text{induced by F})} = c^2 \cot^2 \phi$$

where ϕ is the phase angle of the particle.

It follows that: $(v_L/m_L)/(v_S/m_S) = m_S v_L/m_L v_S = c^4 \cot^4 \phi$. Therefore where $\phi = 90°$ (*electron*) and this ratio equals 0, there will be a very extensive and unsubstantial field (due to spin) and a relatively compact massive body (due to orbital change) and composed almost wholly of rest mass. But where $\phi = 45°$ (*photon*) and the ratio equals c^4 there will be a relatively short-range field of greater intensity of substance, and a relatively diffuse body composed almost wholly of inertial mass.

From the equation $h/c = m_L\lambda$, where m_L is the rest mass of the 'bare' electron, λ becomes the unit of extension, which is the

wave-length of the corresponding 'free' photon, and is the Compton wave-length, $2{\cdot}43 \times 10^{-10}$ cms.

The fundamental units of extension, including both time and space, are represented by *s* which has the general significance attached to it on p. 121.

The units will differ considerably for what can be supposed to be three different magnitudes of space-time, namely (i) the astronomical (ii) the man-sized and (iii) the atomic. The units will be of the order of c for *astronomical space-times*, due to intellect (magnetism); of *unity for human body-space-times*, due to volition (electricity); and of 1/c *for electronic or atomic space-times*, due to emotion (mesonism).

The fundamental electronic unit of extension (*s*) *comprising both time and space* $= s = \lambda/\cos\theta \sim \lambda/\cos 0° = \lambda$, the Compton wave-length.

Where m_L is the rest mass of the electron $m_L = h/c\ \lambda$ so that:— *the fundamental electronic unit of mass* (m) *also comprising both time and space* is $m = m_L$, the rest mass of the electron.

It is of interest to note that

$$s\,(\text{electronic}) = \frac{1000}{137} \times \frac{1}{c}\,; \text{ and } \frac{1}{137} = \text{Sommerfeld Constant.}$$

The relationship between the sense-field and the gravitational field

The reason for the *non-interference of the sense-fields* of percipients (brains) with each other, whilst 'gravitational' fields do normally interfere, must rest upon the extreme 'thinness' of the former relative to the latter. The 'thinness' or unsubstantiality of the sense-field appears to be related to (i) the complexity and resulting massiveness of the association of the fundamental particles within the complex molecules of a brain, (ii) the induced and temporary nature of the sense-field, and (iii) the minute fraction, which the sense-field constitutes of the whole VIF field ('gravitational' field). The fraction is that of one substantial radius (xc of Figure 1) to the total substantial area of three mutually perpendicular great circles of the same sphere, where the circles are taken to be the 'gravitational' field of an

event. Any sense-field is a minute, temporary, induced, part (I) of the whole 'gravitational' field, which is due to the spin wave-change field (VIF), produced by the spin wave-change (S) of an event. Now (excepting a cosmon) a free photon has the thickest field of this kind (S) and it is of only moderate range, because the average rate of the short wave-change ($v_s = 1/c$) is relatively small. A 'bare' electron on the other hand, has the 'thinnest' possible and most extensive field of this kind (S), because v_s is almost infinite in value. 'Ordinary' fundamental particles lie between these extremes. According to Pirenne (*Vision and the Eye*, 1948, page 82), the minimum number of photons required for human vision may be as low as five. Thus the human visual sense-field is induced by a relatively tiny number of photons successfully stimulating, that is to say, 'raising the energy level of' the proper wave-system of a relatively large massive entity—the brain (or its visual centre.) Hence the human visual sense-field is extremely 'thin'. It is not a permanent part of an ordinary 'gravitational' field, but is part of a thinner, induced, and temporary 'gravitational' field, and futhermore, it is only a minute fraction of this field. This is the explanation of the non-interference of the sense-fields of percipients.

Relativity Theory and the Sensum Theory

It is here maintained that Special Relativity Theory has misinterpreted mass-space-time changes in the universe. Its results and predictions have been generally supposed to apply to events. They do not. They apply to visual sensa representing events.

A statement such as: "Events which are simultaneous with reference to the railway embankment are not simultaneous with reference to the moving train" should read "Events leading to simultaneous visual sensa in an observer on the railway embankment do not lead to simultaneous visual sensa in an observer on the moving train." For if, with Einstein, one accepts the absolute and finite velocity of light then in assessing whether there is simultaneity or not, one cannot, as apparently does Einstein, suppose the visual experiences here called sensa, resulting from

light reaching the observer, to be identical with the events from which the light proceeded. Events are never observed directly but only the sensa to which they give rise in observers. The relativity of simultaneity, and relativity theory generally, must therefore refer to visual sensa and not to the events represented.

The 'space-contraction,' 'time-dilatation,' and change of "inertial mass," of relativity theory, will thus rightly be those derived and predicted by the Lorentz Transformation but will refer to visual sensa only and not to events. Nevertheless, for reasons, already given (p. 142), events themselves must be supposed to be continually giving rise to the space-contraction, time-dilatation and change of inertial mass of events. Yet sense-perception (and *scientific observation*) theoretically (*i.e.* by present theory) will reveal space-time changes in the visual sensum, approximating more or less closely in magnitude to those in the event 'perceived', the degree of the approximation depending on the absolute velocities of the event observed and the observer. According to the theory now presented space and time are at bottom abstractions from '*extension*', *which is always a velocity of change*. Each of them in an event is itself a velocity. This, and not special relativity theory, is the main basis of observed mass-space-time changes. Where t and l represent the natural units of time and space respectively of an event, then $t/l = m_s/m_L = v_L/v_s = c^2/\tan^2\phi$, whereas, according to special relativity theory, $t/l = c^2/(c^2-v^2)$.

Thus, where v_L, the difference of the absolute velocities (v_L) of the event and the observer, is equated—wrongly—to the relative velocity, v, of the event observed—but observed only as a visual sensum—and the observer, then we may say that $c^2/\tan^2\phi = c^2/(c^2-v^2)$. If, omitting the observer altogether, we assume the values of v_L to be c and o respectively, for the free photon and the bare electron, then values of ϕ of exactly o° and almost exactly 90° respectively, are obtained. It would follow that the cosmon particle could not then be supposed to exist.

The discrepancies between these values and those in the table on p. 141 are here presumed to be due to the error (in relativity theory)

mentioned above, in assuming a visual sensum to be the underlying event. Nevertheless, the results of experimental science, in so far as they relate to visual sensa, will coincide with those of Special Relativity Theory because this theory caters for visual sensa.

Values of space-contraction, time-dilatation, and increase of inertial mass, can be derived from the following comparable expressions for length, time, and inertial mass.

Present absolutist theory	*Special relativity theory*
$l \propto \tan \phi/c$	$l \propto \sqrt{c^2 - v^2}/c$
$t \propto c/\tan \phi$	$t \propto c/\sqrt{c^2 - v^2}$
$m_s \propto c/\tan \phi$	$m \propto c/\sqrt{c^2 - v^2}$

The differences between the two sets of values is to be explained by the maximum or limiting value of $v = c$ in visual observation and therefore according to Special Relativity Theory, whereas on present theory, v_s and v_L may approach infinity.

The fields and bodies of the factors of the conative process (VF) associated with the cognitive process (VI) of the spin wave-change of an event will be similarly related to α. But these two duplex processes are out of phase by quarter of a spin wave-period. As with the orbital wave-change it is the intrinsically compact conative process (containing the factor of emotion) which determines that half-periods of a definite polarity can exist in the spin change. Otherwise there would be a perpetual neutralisation of the polarity of one duplex process by the other, throughout the period of spin wave-change. At the end of each spin half-period the conative polarity disappears momentarily and the spin space-time would become 'straight' were it not that it is associated with the 'leading' or 'following' faint, 'opposite', polarity of the spin cognitive process (and also with the orbital component of the event). At the commencement of the next spin half-period the 'opposite' polarity (of the already existing cognitive process) is adopted by the conative process. This rapidly reversible series of spin polar changes is comparable to, but is much less in substantial magnitude than, the orbital reversible series of polar changes responsible for the system:

electron ⇌ position (p. 140). In both these kinds of reversible polar changes (spin as well as orbital) 'curved' space-time is continually generating and being generated by 'straight space-time, *i.e.*, potential energy suffers continual reversible change into kinetic energy.

Field Theory

The main *mass* or *body* of an ordinary electron or positron, and of any meson, nucleon, or of any complex event, presumed to be formed from these particles, will reside in the very slow fluctuations of the orbital wave-change components of the event, and will therefore be formed due to the influence of the factor of emotion. For this orbital wave-change similar relationships will obtain, as hold for the spin-wave change, but related to the angle β. But *the spatial extensiveness* of the body and *fields* of an event will largely be due to the extremely rapid fluctuations of its spin wave-change component and therefore to the influence of the factor of intellect. Volitional (electrical), intellectual (magnetic) and emotive (mesonic) fields of one polarity or direction, undergoing only slow fluctuation will therefore be of comparatively short range and, as explained on page 237, will be correspondingly powerful over comparatively short distances. The mesonic field is here supposed to be of much shorter range than the others and to be correspondingly more powerfully attractive or repulsive, depending on the factorial polarities of the particles concerned over these smaller distances. It would follow from the present theory, that the volitional (electrical) factor of the conative process fluctuates concurrently with the associated emotive (mesonic) field. The electrical charge of the "particle" concerned would nevertheless remain constant, not in spite, of but because of, the fluctuations of the electromagnetic and electromesonic processes.

Easily perceptible magnetic and electrical fields will be due normally to the association of the fields of a large number of similar polarised "particles". Although all will be fluctuating, the statistical effect will be one of stability. This would interpret the *electrostatic* and *magnetostatic fields* of complex "events". Mesonostatic "fields" will be difficult to discern owing to the

extremely short range of the mesonic "fields" of "particles."

The extensiveness of the electrostatic, magnetostatic, and mesonostatic fields will be due largely to the presence of the spin component integrated with the orbital component. So will the potential. It is the rapidly alternating polarity of the factorial spin changes overlying and integrated with the more or less slow monopolar orbital fluctuations which provide for the field potential at a point, *i.e.*, the tendency to produce spin 'straight' space-time from spin 'curved' space-time. The magnitude of the potential so-produced at any part will however be largely determined *not* by the spin component, but by the magnitude of the substantial polarity of the orbital component, because the spin change is necessarily integrated with the orbital change.

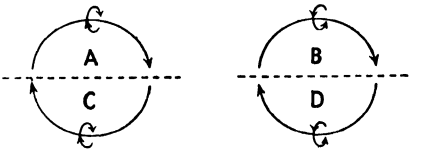
Because of the invariable integration of spin with orbital change the formation, substance, and extensiveness, of bodies and fields will always be due to both component changes. The extensiveness will also be due to the different degrees of intrinsic extensiveness of each of the three factors. Ordinary gravitating 'matter' (and 'anti matter') is neutral and so gravitational effects will be due solely to the spin component. The orbital components will neutralise each other. Such a "field" will be statistically neutral from the view-point of polarity, that is, it will be a *gravitostatic* "field". *It will be very weak relative to the fields underlying the representative electrostatic, magnetostatic, and mesonostatic "fields."* The ratio of related orbital (electrostatic) and spin (gravitational) field intensities is $(v_L/m_L)/(v_S/m_S) = c^4 \cot^4 \phi$. Where $45° < \phi < 90°$ this is of the order of 10^{40} which is empirically correct (Cf. *Nature*, 1952, *169*, 611). The spin-field intensity of an event will be proportional also to the number of the 'ordinary electron' constituents in its body.

The gravitostatic "field" is the ordinary "gravitational field" of science. It is the sensual representative of the underlying field which is solely produced by all three psychic factors of the spin wave-changes of events. In the notation, used on page 99, for the orbital wave-change fields, it would be 'known' as:

$$G = FVI_{field} \times \frac{I}{FVI}.$$

APPENDIX IV

THE POLARITIES AND DIRECTIONS OF MOTION OF EVENTS



A & D both represent the wave-path of an electron—left-hand helix curve.
B & C both represent the wave-path of a positron—right-hand helix curve.

FROM the diagrams, negative and positive polarities of photons, and of derived electrons and positrons are equal in probability, that is to say negative and positive particles are equal in number. If A were to represent the wave-path of an electron (*or* of a negative photon) then B would represent that of a positron (*or* of a positive photon). At the end of each half-wave of the long wave-change then once again there are equal probabilities of the occurrence of C or D. In the second half-wave, C would represent the wave-path of a positron, and D would represent that of an electron.

In this way what would otherwise be the difficulty of relating polarity to direction for events in the universe is seen not to exist. There would be no one set of directions in the universe conferring negative polarity and no one set of directions conferring positive polarity, on an event.

However, all the other attributes of fundamental particles would be provided for, (including—see Figure 3—the rapid and periodic change of direction of spin (S)). If negative polarity of an event were supposed to be produced by left-hand helix motion, then positive polarity would be produced by right-hand helix motion. *The polarity of an event*, in other words, is supposed to be produced by the *integration* of the directions of

the time and space wave-components, and not by the direction of either component taken singly.

The simultaneous 'bipolarity' of the factor of intellect (magnetism) is here supposed to be due to the intrinsic extensiveness of the factor within the *absolute monopolarity of any event* (except the universe). The 'bipolarity' is merely a difference of potential within this one polarity and is made readily observable because of the relatively great distance, between two points, required to make it measurable. Of the other two factors volition (electricity) also gives observable potential differences, but less readily (because intrinsically less extensive) and thus in a similar way may have simultaneous bipolarity, whilst emotion (mesonism) will exhibit this still less readily because of its intrinsically very compact nature. But in addition to this kind of *factorial bipolarity* which merely consists of potential differences within the one polarity of an event, and is therefore only *relative* to this one polarity, there are two *absolute* kinds of polarity. These are the two polarities of events represented by the right-hand and left-hand helix integrations of the spin and orbital wave-changes within the proper wave-systems of events. Of the three factors only the factor of volition (electricity) will reflect these polarities clearly because only for this factor does the factorial magnitude remain constant in any isolated event. Hence there is nothing comparable, at least obviously, for the factors of magnetism and mesonism, to the negative and positive charges of electricity possessed by the "electron" and the "positron" respectively, within these "particles" and therefore within "matter" generally. Yet it would follow that the 'bipolarity' of intellect (and of volition and emotion) may be of two kinds, one founded in the positive and the other in the negative absolute polarities of the proper wave-systems of all events.

Notes 1. *Space and time: the dimensions* L *and* T *of science.*

On present theory these have only conventional importance since they are logically indistinguishable abstractions from 'extension', TL^{-1} having the same significance as LT^{-1}. In other words c and 1/c both denote extension. Moreover, they are only

units of wave-paths which are determined by the mass units of extension of the substantial bodies and fields of events.

2. *The tendency to motion in a spin-field.*

The nature (p. 143) of the very rapid spin-change of a particle inevitably implies phase-change within it and hence not uniform velocity of motion but acceleration. This is shown (p. 119) by the circular nature of the path of an isolated photon as determined by its spin-change. However, there *is* a uniform rate of spin-change in the photon substance corresponding to the uniform speed of circular *motion*, v_s. This is the basis of the tendency to uniform motion (v_L) of an electron at any one locality of a spin-field. The tendency will be proportional to the summation at that locality of the spin-fields of all electrons (positrons) constituting complex bodies situated elsewhere, and also to the number of 'ordinary electrons' in the body of an event at that locality. Gravitational acceleration arises from the differing degrees of this tendency at neighbouring localities—an inverse square effect.

Thus, in spite of what is stated on p. 143, present theory would be in agreement with the Newtonian *definition* of 'force', as being a quantity equal to rate of change of momentum. This may be represented approximately as $m_L a$, the product of rest mass and rate of change of orbital velocity, v_L, of the body affected.

3. *The Red Shift Phenomenon.*

The cosmon phase is postulated to occur only during nebular electron dispersion. Thus a photon will not go through this phase on passing from one nebula to another of opposite polarity. This would allow of the interpretation given on p. 134, which assumes a constant, G, and two parameters, M and R. The interpretation is also allowed by the present picture of the universe, which however differs greatly from that of the last paragraph of p. 135.

4. *The ego, superego, and id, of Freud.*

On present theory the ego is the proper wave-system of the whole person (p. 155), the superego and the id being those respectively of the cerebral cortex and the rest of the person.

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